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Conditions of Contract Work on the Panama Canal.

The unusual conditions which are likely to attend the work of construction on the Panama Canal have to some extent already been indicated by The Engineering Record, but, as the actual execution of contract work is approached, other conditions more unusual than anything hitherto contemplated have arisen. These conditions do not result from a tropical climate nor are they due to unsanitary features of the Isthmus, although both of those sources are productive of contract conditions not ordinarily encountered.

So far as the Isthmian situation can be viewed by an outsider, its affairs are not rapidly improving under the new commission. To those familiar with the situation as a whole, the persistence of yellow fever, evidenced by the few sporadic cases occurring weekly or fortnightly, signifies nothing unusual, in spite of the perversely exaggerated and sensational statements frequently published in the daily press. When it is considered that little, if any, less than ten thousand non-immunes are now on the Isthmus of Panama, the present yellow fever record is sufficiently satisfactory and highly creditable to the sanitary staff of the Isthmian Canal Commission. There is little or no doubt that when the public water supply becomes available to the city of Panama, permitting the complete abolition of the many hundreds of mosquito-breeding water containers, yellow fever will disappear. The same observation is applicable to Colon and to other points along the canal line.

Again, experience on the Isthmus has already shown that malaria can be largely controlled by the sanitary staff. Although the statement will probably not be credited by the public in general, it is probable that malaria and yellow fever will not produce unusual conditions for the performance of contract work on the Isthmus. The apprehension of disease may possibly make the influx of laborers, especially of skilled laborers, a little less free than would otherwise be the case, but if the circumstances of living are maintained as they should be, and as they undoubtedly will be, no other effect need be apprehended.

The great distance of the work from centers of supplies and from the center of authority, coupled with a normal tropical environment, are the real sources of the unusual conditions which are certain to face contractors in the execution of their work. The effects of the tropical climate are usually expressed in terms of malaria and yellow fever, whereas those diseases are preventable and will unquestionably be completely controlled. There are other tropical influences which will exert far greater effects upon the cost of the work and its time of completion.

Every environment will, in the long run, by a process somewhat similar to gravitation, determine the general features of industrial operation best suited to it. The rate of muscular effort in the uniform though not usually excessive heat of the tropics must be much less than in a temperate climate. The fact of that lessened rate of effort leads perfectly naturally to somewhat lengthened hours of work on the Isthmus, but with a different distribution than that to which labor is accustomed in the United States. A day's labor of ten hours has been found to be entirely compatible with satisfactory conditions of labor and living in every respect, the first half of the day, commencing early in the morning, and being followed by a long intermission in the middle of the day when the heat is most intense. All the industrial conditions of the Canal Zone are adjusted to a ten-hour labor day, and no one there has ever thought of it as being in any respect unreasonable or unfitted to the best interests of labor. With the character of the laboring population as it is, and as it undoubtedly will be for years to come, the ordinary laborer is happier and better off in every way, occupied at a moderate pace, for ten hours than for eight. It is most unfortunate for the progress of the canal work and scarcely less so for the canal laborer if the eight-hour day is to prevail in the construction of this great work. With the pace at which work is carried on in this country and under the conditions existing here, the eight-hour day is for the most part reasonable, but nothing can be more fallacious than to suppose that it is equally reasonable on the Isthmus. If such a labor day is to be enforced, the cost of the Panama Canal will not only be greatly enhanced, but the period of construction will also be greatly lengthened.

Another feature of recent development in Isthmian affairs, and a source of grave apprehension, is the instability of its administration. No great public work, or any other work, for that matter, can be conducted economically or efficiently when its administration is subjected every now and then to volcanic upheavals. If the progress of work is to be violently changed during construction, or if the conditions, personal or otherwise, existing at one stage of it are to be fundamentally changed at another stage, a number of serious evils inevitably result. Additional cost to the contractor is so highly probable that his estimates for a tender must be sufficiently high to cover such exigencies, and if they occur after the work is begun, they frequently form the basis of excessive extra claims exceedingly difficult to controvert successfully. On the other hand, such changes always lead to more or less demoralization, often resulting in inefficient and faulty execution of work and not infrequently to great jobs with their illegal or fraudulent profits. The conduct of a great public work should, above all things, be characterized by a reasonable and energetic stability. If faults of administration occur they should be cured promptly, but it is far more desirable to proceed in such a way as to avoid demoralization either in organization or in forces. No contractor in bidding for work on the Panama Canal can afford to tender reasonable prices without assurance of stability in its administration.

The uncertainties of labor conditions may, to some extent at least, be allowed for; sanitary conditions may reasonably be counted upon and the vicissitudes of transportation are not difficult to anticipate, but the effects of instability of administration of the work, with the fundamental changes in the conditions likely to result, and the far-reaching effects of corresponding demoralization, are beyond the power of any contractor to determine.

Fire Protection for Factories.

In their effort to minimize fire hazards, insurance companies are constantly requiring connections of larger and larger size from city water mains to insured factories. Where, a few years ago, a 4-in. connection might have been accepted as satisfactory, these companies now insist upon a 6-in. or even an 8-in pipe. Large service pipes for fire protection are desirable from the standpoints of both insurer and insured. By reducing the fire hazard of an individual factory, they also tend to reduce what is known as the conflagration hazard, and thus, in the aggregate, they prove to some extent a source of benefit to the rest of the community. But each increase in the size of these pipes increases the difficulty of the problems—already vexatious enough—which confront the water works superintendent. He is called upon, and when proper compensation is tendered, cannot well refuse, to allow to be made with his mains connections which are ostensibly to be used only in case of fire, but which, unless the consumer be strictly honest, may be used for stealing large quantities of water for other purposes.

It is true that the insurance companies prohibit the use of these connections for any purpose other than supplying water needed to extinguish fires; but these companies cannot, in the nature of things, exercise any effective supervision over the insured premises, and the water works superintendent must depend largely upon his own efforts to prevent unauthorized use of the facilities he has furnished. The insurance companies very properly object to the presence on the fire protection service pipe of any meter which might interfere with or obstruct the free flow of water through the pipe. This rule bars all displacement meters as well as all other types which can be relied on to register small flows with reasonable accuracy.

The rated capacity of a 6 in. meter may be from 900 to over 2,000 gal. per minute, according to the type, meters of the type allowed by insurance companies having the larger capacity. Such apparatus, after it has remained idle in the pipe for some months, cannot be relied upon to register at all with flows of less than, say, 5 per cent. of its rated capacity. In other words, a dishonest consumer might readily draw from a 6-in. pipe 100 gal. of water per minute, not a gallon of which would be registered by the meter owing to its being clogged by sediment collected during a long period of disuse.

Recognizing the inability of ordinary meters to protect him against loss in case the consumer should happen to be dishonest, most water-works superintendents have heretofore adopted the plan of laying two service pipes to factories, the larger one for fire protection only, and the smaller one, usually metered, for the ordinary daily uses of the premises. All outlets on the fire protection pipes are sealed by the water-works superintendent, who then relies partly upon the rectitude of the consumer and partly upon frequent inspections and eternal vigilance, to prevent the abuse of the fire protection privilege. In most cases no safeguard is required save the honesty of the consumer; but if he wishes to steal, it is practically impossible to prevent him. To say that not all men or corporations are too honest to steal water, and that the exceptions to the rule are so frequent as to demand a serious consideration, does not argue pessimism, but is a simple statement of a well-proved fact.

No business man would care to hand over to a number of other men, or corporations, blank cheques on his bank account, signed and payable to bearer, with no security other than the promise of the recipients that the cheques would not be used. He might reasonably expect that most of these cheques would never be presented; but he might just as reasonably anticipate that occasionally one of the recipients would not be able to withstand the temptation. Some men who would not steal money will steal water, and the water-works superintendent, when he puts in a large fire service, practically issues a blank cheque on his water supply.

Two devices to enable the water-works superintendent to detect any fraudulent use of water from fire protection service pipes have recently appeared. One of these consists of a check valve in the fire service main and a meter on a by-pass around it. The check valve has a differential seat, which, with the by-pass, gives an initial resistance of about 6 per cent. of the available pressure. When the by-pass meter is delivering about 150 gal. per minute, the friction loss through the meter reduces the back-pressure on the check to the equalizing point and any draft in excess of 150 gal. per minute unseats the check and finds unrestricted passage through it. The moment the check leaves its seat a small amount of water flows from the differential seat to the atmosphere through a small indicating meter, which will register so long as the check is off its seat. This device will measure accurately ordinary small drafts, will give an unrestricted amount for use during fires, and will indicate the approximate length of time when any such large drafts occur.

The second device consists of a check valve with its clapper resting on a differential seat, like that above described, but provided with a considerable weight forcing it closed. A material by-pass extends around this check, and is provided with a substantial valve of simple construction. This valve controls the flow through the by-pass meter when the main clapper is off its seat and keeps this flow a constant proportion of the total flow through the main channel. This permits a quite accurate measurement of large flows and the accurate measurement of small discharges.

Each of these meters has been sufficiently tested to show its practicability, and has been developed with equal regard for the protection of the water department's interests and the need of large volumes of water during fires. Probably an ingenious water thief can find some way of beating them, for no gas, electric or water meter is safe against such a man. On the other hand, these appliances will serve in practically all cases as a deterrent and detector of any unwarranted use of fire services. The fact that they have been placed on the market is in itself a proof of the necessity of keeping watch on these large fire mains.

The Folly of Broad Claims for Highly Superheated Steam.

Every now and then reports come from abroad of the wonderful performance of some engine using highly superheated steam. The account published in The Engineering Record of June 17 is an instance in point. As little as 9.1 lb. of steam per indicated horse-power per hour is claimed to be consumed by the engine noted when running at nearly full load, and the builders are no doubt receiving many compliments for their ability to turn out what is alleged to be such a remarkably economical machine. There is a deal of folly in all these claims of great universal economy of highly superheated steam, and it is time to bring to the surface some of the facts which are not usually recognized by laymen and less often advertised by those who sell superheating apparatus, and thus put the matter squarely on its merits.

The engine in question, which was a 500-h.p. cross-compound, having cylinders 21 and 36 in. diameter by 36-in. stroke, was used in operating a cotton mill. It is presumed that it worked the usual time for a day's run, for it is reported that it stopped for both the breakfast and the dinner hours according to English custom and doubtless at night also. The superheater was an independently-fired apparatus, of the Schmidt type. From the superheater to the engine throttle there was 121 ft. of pipe, varying in size from 8 to 6 in. diameter. The outside of the pipe was protected from radiation by non-condensing covering about 5-in. thick.

When developing 481 indicated horse-power, which was the nearest load to the rated power of any of the series, the amount of superheating at the throttle valve being 395°, the steam consumption was 9.1 lb. per indicated horse-power per hour, the quantity already quoted. Comparing this figure with the usual consumption of good saturated steam engines, which is known to be from 13 to 14 lb., it would appear at first sight that there was an advantage of 33⅓ per cent. in favor of the superheated steam engine. If this were the actual fact there is the best ground in the world for superheater advocates to be elated over the result. This, however, is only the surface indication. There is a "lid" on, concealing matters which have the most vital bearing on the whole subject, and it is worth while to take the lid off, so far at least as it concerns the result obtained on the English engine just tested, and seek the facts.

The advantage of a superheated steam engine—if it has any superiority at all—over a saturated steam engine, must lie in its greater economy of operation. Economy of steam consumption is not one of the economies of operation unless the water supply of the boilers is one of the elements of expense, and where it is so it forms at best an insignificant item. It is principally economy of coal, if anything, which superheating must secure, to make it advantageous. In the English case before us it is the working economy of the superheater in the ordinary daily operation of a cotton mill plant. It is not the coal economy obtained for a selected hour or two, such as pertained to the tests reported, when all the conditions favored the superheater, but rather that obtained during the entire 24 hours of a day's run. It is the coal burned during the 24 hours that constitutes a day, or the 168 hours that constitute a week that must be purchased and paid for, and it is, therefore, the coal saved under the working conditions of the factory which must determine whether the superheater is advantageous or not.

Neither the records of coal for the short periods of the tests nor for the long periods of actual service are given in these reports, and, notwithstanding its vital importance, no reference whatever is made to the subject. The matter of coal consumption is kept under the "lid." There is information enough about these matters, however, in the data which are given, and in what may be obtained from other trustworthy sources to furnish a good idea regarding these omissions.

It takes coal to superheat steam. Even a layman can see this, especially in a case like the one in point where a separate furnace is used for heating the superheater. Prof. Jacobus found in a test of a Schmidt superheater, running continuously (see A. S. M. E. Transactions, Vol. XXV, page 264), that one pound of steam required 0.0246 lb. of coal to superheat it 443°, this being about the temperature which must have been obtained at the superheater of the English plant.

We cannot use Prof. Jacobus' continuous test, however, as applying precisely to cotton mill conditions. Here, as already observed, they are not by any means those of continuous running, for the superheater fire is slowed down at noon-time and at breakfast, and it is stopped altogether and banked during the night, causing the superheater to cool down several hours out of the 24. These conditions are the source of a great loss of coal. It is a somewhat different apparatus from a boiler, for the reason that the brickwork of the setting is a comparatively large mass and it is very hot. Consequently the night loss of fuel is excessive, and it is easy to believe what those who have tried it say, that, instead of requiring 0.0246 lb. of coal to superheat a pound of steam 443°, as is done with continuous running, it requires at least 50 per cent. more, or 0.0369 lb., in the cotton mill, and this amounts to 0.336 lb. of coal for the 9.1 lb. of steam used on the engine in question per indicated horse-power per hour. If the evaporation of the boilers were 10 lb. of water per pound of coal, the weight of coal used per indicated horse-power per hour works out 1.246 lb. For the ordinary saturated steam engine with a water rate of 13.5 lb. and the same evaporation, the coal consumption works out 1.35 lb. per indicated horse-power per hour. The difference in favor of the superheating is 0.104 lb., or 7.7 per cent. Instead of there being an advantage of 33⅓ per cent., which the steam test shows, there is only one-fourth of this saving in coal consumption, which is a mere bagatelle.

But this is not all. A superheater outfit of this kind costs about $4 per horse-power, and the extra cost of the superheated steam engine, less the practical saving in size of boiler plant, is sufficient to bring the total extra cost of the entire plant to at least $5 per indicated horse-power of the engine. A fair charge for interest and depreciation on a superheater plant is 20 per cent. per annum, or $1 per indicated horse-power per year. One dollar per indicated horse-power per year is about 10 per cent. of the cost of coal for a saturated steam engine in such a mill as the one referred to, when the price of coal is $4 per ton.

To sum it all up, the saving from the superheated steam in this case is insufficient to meet even the fixed charges on the necessary installation, and the owner who pays the coal bills is out of pocket from the very beginning. Is it any wonder, therefore, that the advocates of highly superheated steam engines have so much to say about the wonderfully low steam consumption of their machines, and almost nothing about their coal consumption and working economy of operation, which are zealously kept under the lid? The Engineering Record is in no sense opposed to the use of superheated steam, and, in making these comments on a single case of its use, desires simply to point out that superheating must be approached very carefully in every case and no general claims of great economy for high temperatures are likely to be very reliable.

Standard Methods of Water Analysis.

The standardization of methods of technical analysis and tests of materials now occupies a prominent place in the thought of laboratory workers. It represents a stage of development. It took many years for the engineering and manufacturing world to appreciate the practical value of the laboratory; but once realized, the laboratory idea spread rapidly. Many laboratories and many workers have brought out many modifications of analytical procedures, and this has sometimes resulted in confusion and conflict. To avoid this confusion and conflict standard procedures, standard reagents and apparatus, and standard methods of expressing results have becomes necessary. What is true of technical analyses, such as tests of cement and of iron and steel, is true of the analyses involved in sanitary investigations. It is especially true of water analysis, where, because of the delicate nature of the chemical and biological processes involved, slight differences in technique may produce widely varying results. The final report of the Committee on Standard Methods of Water Analysis presented to the Laboratory Section of the American Public Health Association at its last annual meeting and recently published by the "Journal of Infectious Diseases," is therefore an important document and one which cannot fail to have a beneficial influence on this branch of sanitary science.

The report represents the culmination of five years' work on the part of several of the most active water analysts of the country, with whom have co-operated chemists and bacteriologists representing the leading laboratories. It covers, in great detail, the entire field of water analysis, physical, chemical, microscopical and bacteriological. Under the latter topic it includes a revision of the Report of the Bacteriological Committee of the American Public Health Association, published in 1897, which up to this time has remained the standard code of procedure in America. Its continuity thus makes the report of special value.

In comparing the analytical determinations recommended for various classes of waters with those in common use a decade ago the engineer will doubtless be impressed with the greater emphasis now given to the biology of water, and he may be somewhat surprised to notice the limitations which have been placed upon such well-known chemical determinations as the "free ammonia" and "albuminoid ammonia." He may be equally surprised to observe the emphasis placed upon the physical examination and upon the determinations of mineral constituents. The latter have been made necessary by the recent progress in the arts of coagulation and water softening. Prominent among the bacteriological determinations is the test for the colon bacillus, and the difficulty of correct diagnosis is attested by the somewhat elaborate schedule of tests outlined. It is hoped that adherence to these strict tests, both quantitative and qualitative, will do away with some of the uncertainty which has surrounded our ideas regarding the distribution of this organism in surface waters and the significance of its presence from a sanitary point of view.

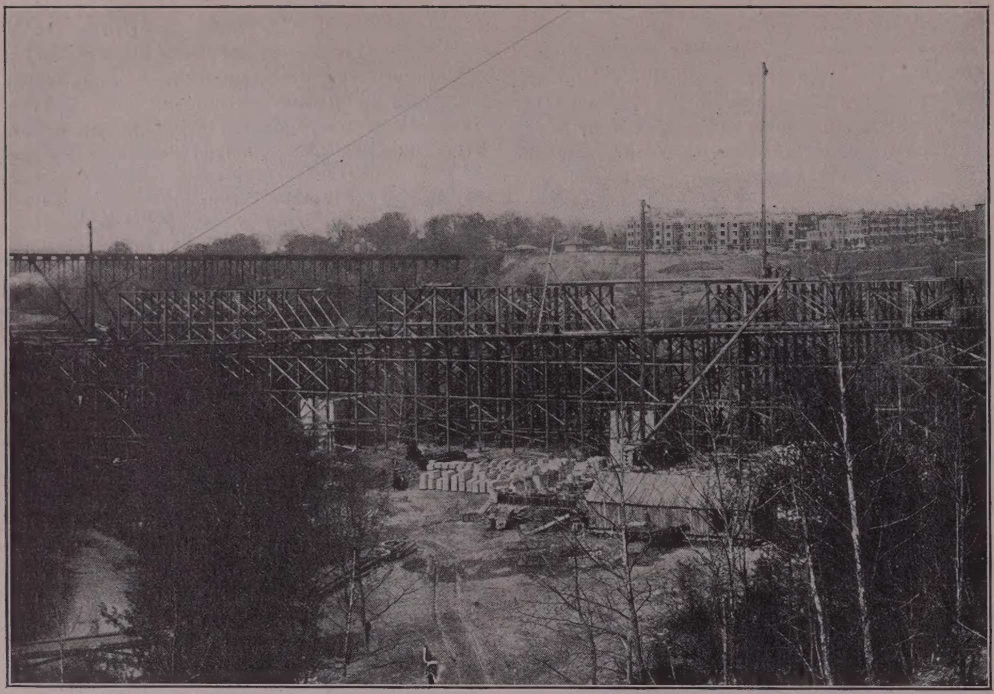
There are those who believe that standardization of methods tends to stifle originality and snuff out the light of progress, but The Engineering Record holds that, on the contrary, they tend to advance the state of the science by bringing the delinquents and stragglers up to the line of the foremost, and by discouraging a fresh start in new directions. Standard methods must always be used with discretion, and doubtless the members of the committee would be the first to depart from the letter of the law if the technique prescribed should prove unsuitable in any particular case. The report, as the committee states, represents the best current practice of American water analysis, and its methods are presented as standard of comparison rather than as instructions which are to be followed blindly. When, however, different methods from these recommended are used, much will be gained in clearness of thought if this fact is mentioned in reporting the results.

Notes and Comments.

The Interest in Pumping Engines at the present time has led The Engineering Record to secure from Mr. Nicholas S. Hill, Jr., the discussion of the subject which is commenced in this issue. Pumping engines are viewed in different lights by purchaser and builder, and the best way to clarify the existing confusion regarding a number of features of such equipment is to discuss them openly. Mr. Hill takes up the subject from the point of view of the purchaser, who looks upon the fuel, interest and depreciation charges against an entire pumping station with much more interest than on the duty attained by the engine or any other single portion of the entire plant. Full opportunity for discussing the subject will be afforded.

The International Association for Testing Materials has probably lost a considerable revenue on account of its failure to show some slight degree of business courtesy toward the American Society for Testing Materials, which has been sending it large sums annually as the dues of all its members in the international organization. Not only has it been extremely difficult to obtain a receipt for these remittances, but even the very infrequent official letters sent by the American Society to the other body have rarely been answered. Moreover, the International Association has done nothing, so far as can be learned here, for some years. Its convention has been postponed from year to year until most American members have lost faith in its ever taking place, and for several years nothing but a few unimportant circulars have ever reached them. It is impossible for the International Association to do anything toward standardization of specifications, because in Europe the governments do not wish such action and without their co-operation nothing of any importance can be accomplished. All that is practicable is to adopt uniform methods of conducting tests, and this seems to be out of the question with respect to numerous classes of material. For example, no American purchaser of foundry material would care to employ the specifications of German purchasers, and the rigid American requirements for bridge material could not be approved in Germany and France without hardship to the steel producers; as the specifications differ so widely the methods of commercial testing must also differ. These remarks do not apply to research testing for the purpose of investigating the properties of the materials of engineering, however, and in this field there is no question that American and foreign engineers should work in harmony. It is desirable, for this reason, that no break should occur between the American Society and the International Association, and the best way to prevent it, while shaking off of the American Society's shoulders the heavy financial load it is now carrying without any tangible result, is that suggested by its executive committee. This is in substance to withdraw all the Society's members from individual membership in the Association and to have the Society become a member as a body, paying not only the regular dues, but also an annual voluntary contribution of at least $100. American engineers can then join the International Association directly as individuals and the American Society will not have to pay their annual dues.

The Resignation of Mr. Wallace from the Isthmian Canal Commission is a matter so serious that it deserves the thoughtful attention of engineers and contractors contemplating work on the Isthmus. The newspapers have contained two "official statements" concerning the steps leading up to the resignation and a lot of irresponsible comments from friends of Mr. Wallace and of the people in Washington who desire to see the government methods of awarding and breaking contracts remain as they are. It will do no good to anybody or to the progress of the Isthmian Canal to talk in detail about what has taken place. Nobody believed that Mr. Wallace would remain in office if the usual business methods in Washington were allowed to creep into Isthmian Canal affairs. He has an enviable reputation as a railroad manager which makes his friends confident that he did not give up his great office for any considerations of salary, but because, as indicated in his public statement, "the obstacles due to the governmental methods required by existing laws are so serious that they will have to be eliminated if the American people are to see the Panama Canal constructed in a reasonable time, and at a moderate cost." It is to be regretted that Mr. Wallace did not state more fully what these defects were and how they act not only to hamper the progress of work, but also lay the way open for scandal. It is inevitable that there will be men connected with the government in one form or another, perhaps as clerk and perhaps as cabinet officer, who will be financially interested in companies which would like to bid on some of the multifarious supplies required on this great undertaking. Under the laws the award of a contract to such a company makes the office-holder interested in it a criminal liable to imprisonment. Consequently, the legal obligations attending the purchase of supplies under the present laws are very likely to cause trouble to high officials accustomed to the freedom of private business transactions, and not familiar with the legal restrictions on government employes of every rank. Under these circumstances it is not conceivable that a man of Mr. Wallace's nice feeling of justness could remain in office as chief engineer. It is hardly possible, moreover, that his successor will prove any more willing to close his eyes to the bad systems that have grown up to threaten this work with scandal, and, in fact, it is very likely that if placed under the same influences that have doubtless led Mr. Wallace to take his course, Mr. Stevens would give the public the very frank explanation of the danger of governmental contracting methods which it ought to have. The retiring chief engineer has seen fit to pass back into civil life without making such an explanation, doubtless believing that anything he could say would be considered ex parte and influenced by his controversy with the Secretary of War. The fact remains that those who have been conversant with Isthmian affairs since the resignation of the former commission are not wholly surprised by recent developments. It is only just to add that these comments are made without any direct or indirect information received from Mr. Wallace concerning his resignation, other than his published statement.



Falsework, Service Track, Platform for Molding and Storing Blocks.

THE CONNECTICUT AVENUE CONCRETE ARCH BRIDGE, WASHINGTON, D. C.

A Description of the Progress on a Monumental Structure.

Connecticut Avenue, Washington, is a main thoroughfare for a handsome residential district. About three miles from the Capitol it crosses Rock Creek at a maximum height of about 120 ft. above the valley. The height and length of the bridge and its location near other roads and park grounds make it conspicuous, and on this account and because of its importance and necessarily expensive construction and the character of the surroundings, it was determined to make it a dignified landscape feature.

The design is somewhat modified from the plan submitted by the late George S. Morison and awarded the first prize in the competition of 1897. It is a concrete structure 1,341 ft. long and 52 ft. wide, with seven full-centered arches of 82 ft. and 150 ft. clear span. It has a 35-ft. roadway and two sidewalks 8 ft. wide in the clear, and is designed to carry besides pedestrian and vehicular traffic two electric street car tracks with conduit wires and several lines of gas, water and electric mains. Work on the foundations was commenced in 1889, between which time and 1901 they were built under several separate contracts. The work was delayed on account of the appropriations, which varied from $15,000 to $25,000 per year and were entirely omitted in some years. It is now estimated that if future appropriations are adequate and prompt the work will be completed in 1906 at a total cost of about $800,000. All the pier foundations have been built, one abutment and one of the 82-ft. arches have been completed, and work is now in progress on all the 150-ft. arch piers and in the construction of the molded concrete blocks.

The arches are hingeless and are made without any steel reinforcement. They are built integral with the upper parts of the piers and have offset footings on their extradoses for the piers of smaller, full-centered, 14-ft., spandrel arches which carry the level asphalt roadway on a thin earth fill. The face rings of the arches, the corners of the piers, the molded courses, and in general all the trimming below the granite coping, is made with molded concrete blocks with fine, tool-dressed surfaces. The exposed surfaces of the monolithic concrete are bush-hammered to remove marks of forms and give uniform color. The upper surface of the concrete under the roadway fill is waterproofed, and drain pipes are built into the arches and piers to prevent the accumulation of any water that may penetrate below the roadway. Expansion joints are made in the spandrel arches and in the long abutment walls to provide for temperature movements.

The rectangular footings for the main piers have vertical faces and are carried down in open cofferdams to solid rock at a maximum depth of about 40 ft. below the surface. They are made of concrete proportioned one part Vulcanite Portland cement, 2½ parts sand, 3 parts gravel and 4 parts 2-in. broken stone. These unit quantities yielded 29.0 cu. ft. of concrete rammed in place.

The main piers have rectangular cross-sections with re-entrant angles at the corners and are battered 1:24 on all faces. Up to the top of the skewbacks they are made solid; above that level they are chambered, the longitudinal and transverse spandrel walls continuing the faces of the piers up to the roadway. The corners of the piers and the projecting courses are made with molded blocks laid up like stone masonry and bonded into the backing of concrete, made 1 part Dragon Portland cement, 2½ parts sand and 6 parts 2½-in. broken stone.

The monolithic arches are proportioned for a total live load of 135 lb. per sq. ft., and for the 150-ft. spans are 5 ft. thick at the crown and about 10 ft. thick, radially, at the skewbacks. They are made of concrete mixed 4.5 cu. ft. cement, 9 cu. ft. sand and 20.25 cu. ft. broken stone, which yields 21.4 cu. ft. concrete rammed in place. Offset footings on the extrados receive the transverse spandrel walls, which are connected at their tops by the roadway arches of 14-ft. span and a thickness of 12 in. at the crown. The spandrel walls and arches are made with concrete of the same grade as that used in the piers, and the upper surface of the spandrel arches, together with that of the main arches at the crown between the spandrel arches, is covered with a layer of concrete having its upper surface parallel with that of the arches near their crowns, and thus forming a sort of transversely corrugated platform continuous from one end of the bridge to the other. The thickness of this concrete is 12 in. at the crown of the spandrel arches and about 60 in. at the crown of the large arches, and it is made with 4.5 cu. ft. of cement, 13.5 cu. ft. of sand and 45 cu. ft. of gravel and yields 45 cu. ft. of concrete rammed in place. The upper surface of the concrete is painted with tar and covered with 6 in. of gravel and a fill of clean earth rolled in 12-in. layers with a 5-ton roller and compacted by ramming. The upper surface of the fill is dressed to sub-grade, covered with concrete and asphalted.

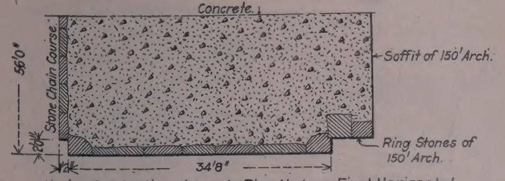
Face walls on the ends of the arches are continuous from end to end of the bridge and are built, up to the coping stones, of concrete like that used in the piers. These walls are about 7 ft. high over the crowns of the main arches, 3 ft. thick at the base and 4 ft. thick at the top, where they are recessed to receive the course of molded cornice blocks under the coping of cut stones 6 ft. 9 in. wide and 26 in. high which are anchored to the concrete with vertical cramp irons 4 ft. apart. Large cut-stone balustrade posts are seated on the coping 15 ft. apart and are secured to it with two long dowels in each. The face walls under the coping are each reinforced with two horizontal, 4x1-in., steel bars, 20 in. apart, set edgeways and connected by ¾-in. bolts, 2 ft. apart at the ends and 4 ft. apart in the middle of the span, which have at each end two nuts screwed up against opposite faces of the bars.

The spandrel arches are reinforced so that if the crown joints open by temperature contractions enough to separate them and make them act independently, the semi-arches will have adequate strength as cantilevers. In the center of each 150-ft. span there is a vertical transverse expansion joint ½ in. wide, extending across the bridge through the face walls and the concrete on top of the main arch. In the face wall the horizontal cross-section of this joint is a rectangular loop 12 in. wide, forming a tongue and groove which locks the two parts of the wall together. Similar joints at the crown of each spandrel arch are filled with lime mortar.

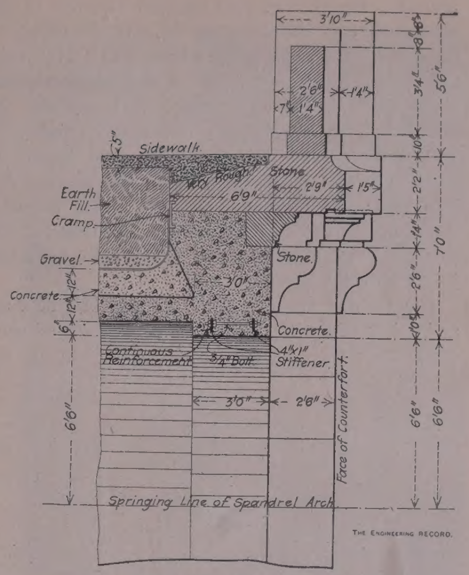
The abutments form in plan three sides of a rectangle about 135 ft. long and 52 ft. wide, outside, with concrete walls having vertical outer faces and interior offsets. Their maximum height is 50 ft. and their thickness is 20 ft. at the bottom and 4 ft. at the top. The space between the walls is filled solid with earth, rolled and rammed like that above the arches. Each side wall has two vertical expansion joints made with a 15-in. rectangular tongue and proove 12 in. in the clear from the outer face and reaching from the bottom to within 8 ft. of the top, where, the thickness being only 4 ft., it was discontinued and a flat butt joint made the rest of the way, with horizontal steel tie bars across it connecting the adjacent parts of the masonry. An 8x8-in. rectangular well reaches from top to the bottom of the wall at each joint and is made half in one side and half in the other. It is filled with puddled clay to prevent possible seepage through the joint, and has been found satisfactory when the joint opened and closed with a total movement of ⅛ in. due to differences of temperature between summer and winter weather.

Concrete stone is quarried in the hillside near one end of the bridge, hoisted by derrick to the top of an incline, and is delivered by a friction hoist in 2-yd. steel end-dump cars to the stone-crusher platform, and the cars are sent back to the quarry by gravity. The crusher has a capacity of about 350 cu. yd. of 2½-in. stone in 10 hours and delivers to a large stone pile under the bottom of which a trench has been excavated and lined to make a tunnel, with horizontal steel sliding gates in the roof, through which the broken stone is drawn into 3-yd., side-dump cars and hauled by cable up a second incline about 125 ft. long and 35 ft. high to a storage bin in the top of the concrete tower, where sand, delivered in the same manner, and cement, chuted down from the top of the bank, are measured and are passed through the gravity mixer. Concrete is discharged from the mixer into steel buckets and distributed along the bridge on a parallel track carried at a 2 per cent. down grade on the side of the falsework at about 30 ft. above the springing line of the main arches. The bucket cars are returned to the mixers by a steel cable operated by a hoisting engine.

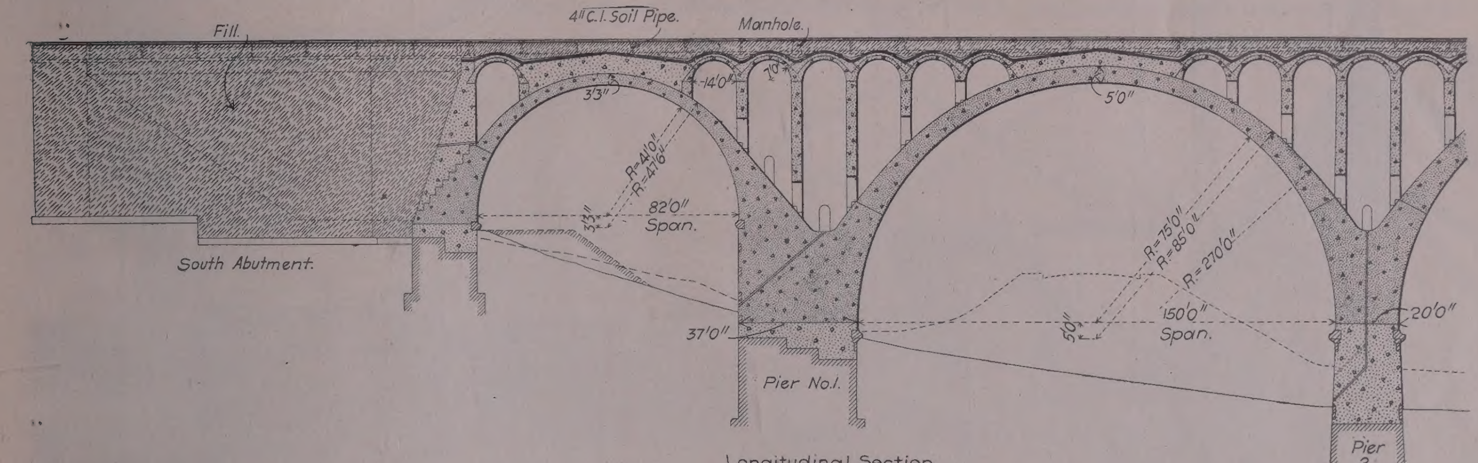
The concrete buckets are handled by seven 90-ft. and four 70-ft. boom derricks of 7 tons capacity and two stiff-leg derricks with 50-ft. booms, all operated by Lidgerwood and American Hoist & Derrick Co.'s engines. Each of the large derricks is rigged with six 1-in. guys, and there are two spare masts kept in reserve that are interchangeable with all derricks, and are set up in advance and the booms merely moved from the old masts to them when it is necessary to shift derricks. The old masts can then be removed at leisure, and the operation of the derrick is only interrupted while the boom is being shifted, thus saving a large amount of time to the masons or concrete men served by the derrick.



Horizontal Section through Pier No. 1 on First Horizontal Chain Course below 82-Ft. Arch Impost.

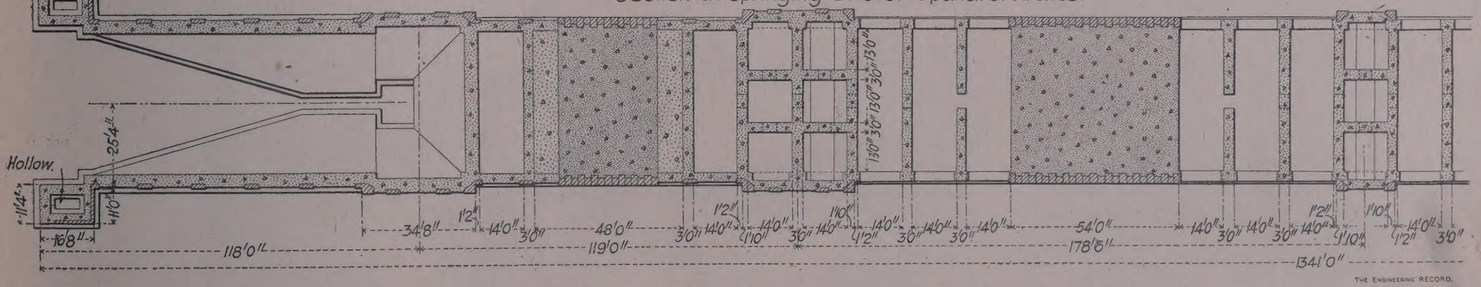


Transverse Section of Bridge at Crown of Spandrel Arch over 150-Ft. Arch.



Longitudinal Section.

Section at Springing Line of Spandrel Arches.



Large and Small Arch Spans, Pier and Abutment of Connecticut Avenue Bridge.

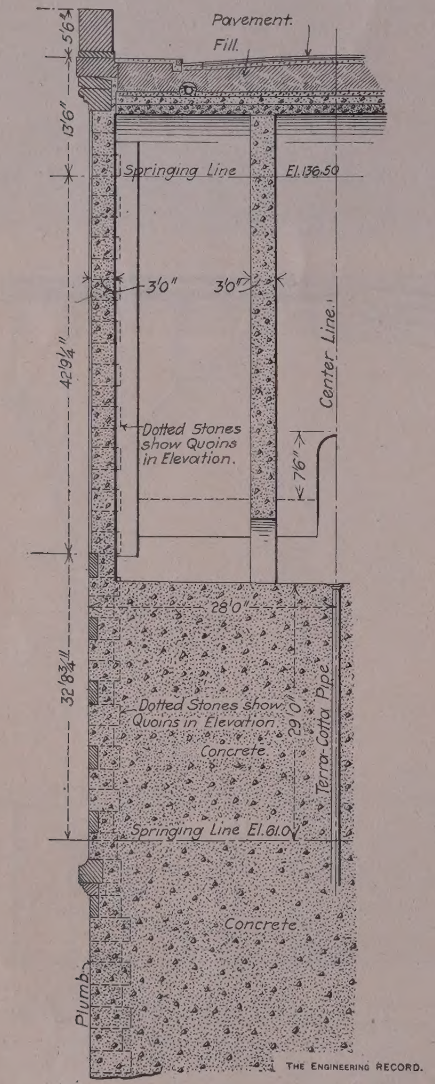
Above the surface of the ground the forms for the piers are made by building up the molded quoin blocks in vertical tiers like masonry courses, with 1 : 1 mortar joints, and thus providing solid corners, to which face boards are attached for the sides. The concrete is mixed very wet and is placed with very little ramming. Not more than 5 ft. in height of concrete is laid above the portion which is set, and the faces of the molds are tied together by permanent horizontal rods with end connections to sleeve-nuts 3 in. in the clear inside the face of the masonry. After the piers are stripped these sleeve-nuts are disconnected from the outside stubs and the latter removed and the holes filled with cement mortar. The molds are made with ⅞-in. tongue and groove, horizontal boards planed and oiled inside and supported by 2x8 in., vertical studs, 18 in. centers, held in place by 8x8-in. horizontal wales, 7 in. on centers, secured by ¾-in. horizontal through bolts 8 ft. apart.

The arch molds are extended about 30 ft. above the springing lines of the arches on templates where the side faces of the piers are tangent with the intrados of the arch, and the curve of the latter diverges but little from the vertical, so that the concrete imposes very little vertical pressure. Arch radii through the upper edges of these pier molds make angles of about 30 degrees with the horizontal; up to them the concrete is deposited in horizontal layers monolithic with the piers and the two adjacent arches; above them it is supported on ordinary ⅞-in. tongue-and-groove dressed lagging parallel with the axis of the arch and supported by framed falsework.

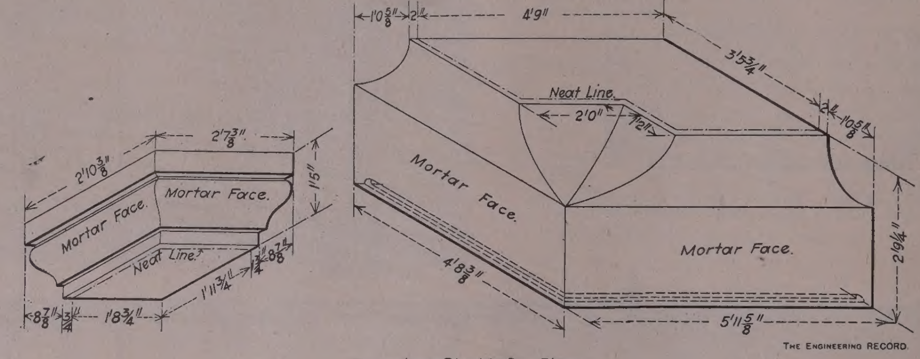
All the 150-ft. arches will be built simultaneously, and the concrete in them will be laid continuous from the springing line for the first 30 degrees of the ring, the work progressing continuously as far as practicable. Above the 30-degree points the arch rings will be built in horizontal strips, 10 ft. wide, with eight 3-ft. spaces between them, which will be concreted afterward.

The arch centering is made, as shown in the elevation, with vertical falsework posts supported on pile foundations. The lagging is supported on 2-in. scarf boards, which are little more than thin fillers seated on inclined, 3-in. longitudinal pieces, and preventing a wasteful trimming of their upper edges. The latter are intermediately supported by center diagonal braces and are seated at the ends on transverse caps bearing on pairs of oak wedges, with the grain parallel to the inclined surfaces. The vertical posts are made in 32-ft. pieces with square ends, hand planed to bearing on adzed caps and sills. The latter are continuous with butt joints on the post tops, to which they are secured with ½-in. dowells. The vertical posts are braced with 3x8-in. diagonals having one ¾-in. bolt at every intersection, and by longitudinal and transverse, horizontal struts with square butt ends carefully fitted and supported by cleats and wooden scabs, not shown on the drawing. A horizontal platform will be built on the upper longitudinal struts or deck and loaded with ballast of the equivalent of the full weight of the crown section of the arch before the latter is built in order to take up all settlement and compression before the final construction, and as the concrete is laid the ballast will be gradually removed so as to maintain approximately uniform loading.

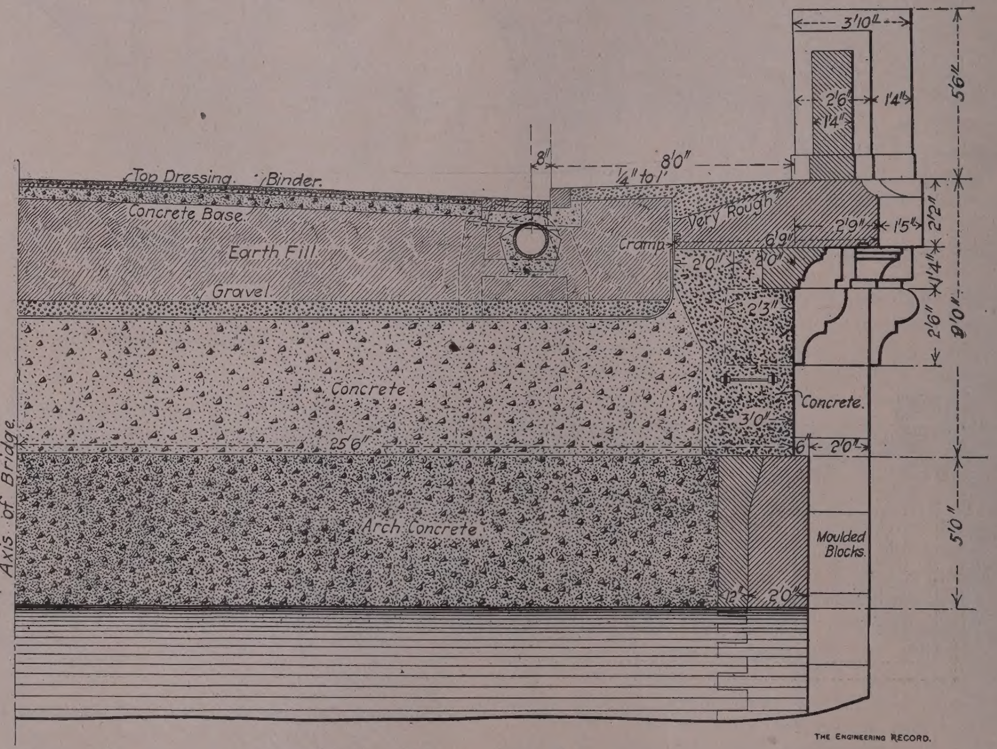
The falsework is supported in most places on piles driven to a penetration of 20 to 50 ft., and to a refusal of ⅕-in. under a 15-ft. drop of a 2,000-lb. hammer or the equivalent ⅓-in. under a 20-ft. drop. Some of the piles penetrated the rotten rock 10 ft., and they are loaded to a maximum of about 25 tons each. Some of them were tested with a load of 38 tons of pig iron each, which caused a settlement of 3/8 in. in 24 hours and recovered 5/16 in. after the load was removed. In the bed of the creek and under the Woodley Lane Bridge, which intersects the line of the bridge, it was impossible to drive piles, and the falsework posts were supported on concrete piers carried to rock with an average height of 12 ft. They were 3 ft. square on top and 6 ft. square at the bottom. A 4-in. pipe line under pressure of about 125 lb. from the city water works is carried the full length of the falsework, and a valve and hose at every span is provided for keeping the timber always very wet, not only to prevent danger of fire, but to maintain swelled joints. It is hoped that when the arches are completed and the falsework is dried out the shrinkage in the timber will be sufficient to strike the centers and swing the arches clear without the use of wedges.



Half Section through Pier between 150-Ft. Arches.



Trimming Blocks for Piers.



Section through Crown of 150-Ft. Arches.

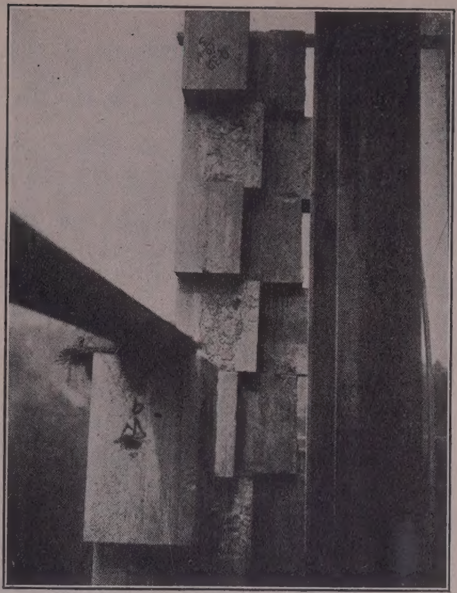
Principal Cross-Sections of Viaduct, and Typical Molded Blocks

A service platform, from 20 to 24 ft. wide and about 70 ft. in maximum height, is built from one abutment to the other close to the face of the masonry. The regular floor beams are supported at one end on bearing blocks, spiked to the faces of the falsework posts, and at the other end rest on the tops of independent vertical posts, beyond which they cantilever about 3 ft. They carry two 38-in.-gauge tracks and three lines of footwalks. There are horizontal, longitudinal and transverse braces about 16 ft. apart in all panels, and at the piers of the bridge the three bents are braced together with diagonals in each panel to make towers. The cost of framing and erection of the falsework was about $9 per M. The framing of the bows, which has not yet been done, will probably cost $14. The total cost of the falsework was about $50,000, of which there will probably be about $15,000 salvage, as the square timber is very little cut or injured. The same timber is used over two or three times in the forms. All lumber is cut by hand excepting that a small steam-driven band saw is used for cutting out the small curved blocks which when spiked to the joists form the bows.

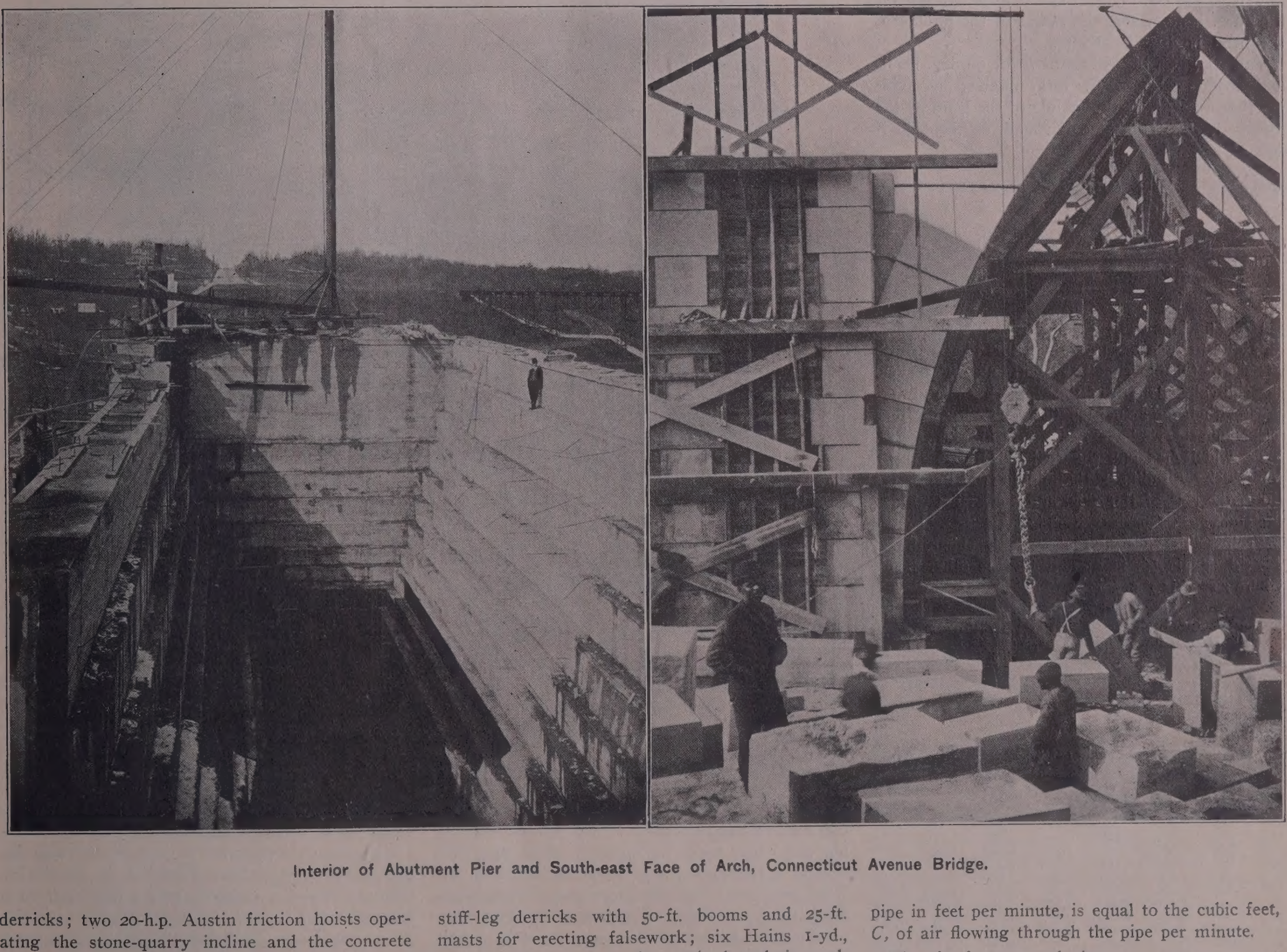
The molded blocks for the quoins, belt courses and other trimming below the coping are of concrete made with 4.5 cu. ft. of cement to 9 cu. ft. of sand and 20.25 cu. ft. of broken stone, faced on all exposed sides with 1 in. of mortar made 1 part cement and 3 parts crushed granite, screened through a 3/8-in. mesh. All of these blocks are accurately dimensioned and marked to correspond with the detail drawings of all the courses in the bridge. Each block has a course letter, and a number and records are kept of their construction and the tests of the concrete used, and the blocks are dated as made so that none of them are built into the work until at least 60 days old. The blocks are made in wooden molds with collapsible sides, bolted together and fitted with six bottoms so that they may be stripped from the finished block when many duplicates are required and a second successive block made, while the bottoms are left under them until they are thoroughly set.

The molds are cleaned and oiled before making each block, and care is taken to have the principal exposed face of the block on the bottom of the mold, thus avoiding the injurious effect which would be produced by flushing the cement on it if it were on top. The mortar facing for the exposed sides of the block, which are always vertical in the molds, is placed with the aid of thin vertical steel plates 12 in. deep and as wide as the faces of the block. These plates are put in the bottom of the mold parallel with the face and 1 in. distant from it. Mortar is filled in outside, and concrete backing is simultaneously rammed inside to the tops of the plates, and the latter are raised until their lower edges are 3 in. below the top of the concrete, when the filling and ramming is repeated, and so on until the mold is filled and the plate or plates withdrawn.

After the blocks have set 24 hours they are stripped and covered with canvas and thoroughly wet twice a day for two weeks. Cavities are formed in the backing faces of the blocks to improve their bond with the monolithic concrete. At first they were made by cutting out the half-set concrete, but the inspectors sometimes objected to having this thrown back into the fresh concrete, and now the cavities are made more easily and satisfactorily and without waste by simply forcing a wooden block into the surface of the fresh concrete. After the blocks have set 40 days, lewis bolt holes are made in them with pneumatic hammers and the exposed faces are dressed with 4-cut, pneumatic, bush hammers in machines made by H. G. Kotten, New York, and operated by Ingersoll-Sergeant air compressors. Molded blocks are dressed by hand, and the exposed surface of all monolithic concrete is dressed by pneumatic tools, giving it an appearance of cut stone. The blocks are molded on a horizontal wooden platform about 90 ft. long and 90 ft. wide, with solid, well-leveled foundation sills. A guyed derrick in the center commands the working surface and handles the concrete, molds and finished blocks, which are stored adjacent to the platform, and reaches to the track on which concrete from the mixer is distributed along the line of the bridge. About 20 cu. yd. of blocks are made daily at a cost of $15 per yd., as compared with the estimated cost of $50 per yd. for granite cut to the same dimensions.



Bond of Quoins Forming Skeleton of Mould for Pier I.



Interior of Abutment Pier and South-east Face of Arch, Connecticut Avenue Bridge.

The principal items of plant now installed at the bridge site include two 12-hp. and three 20-hp. hoisting engines made by the American Hoist & Derrick Co. and operating two stiff-leg and three 90-ft., boom-guyed derricks; one 20-hp. Mundy hoisting engine operating the quarry derrick; one 25-hp. Florey hoisting engine operating the service track cables; three 20-hp. Lidgerwood hoisting engines operating the 90-ft. guyed-boom derricks; two 20-h.p. Austin friction hoists operating the stone-quarry incline and the concrete tower incline; one Wick Bros. 120-h.p. boiler for the crusher plant; one Atlas 100-h.p. stationary engine operating the stone-crusher plant; one No. 6 Austin Gyrator stone-crusher, with a capacity of 400 cu. yd. per day; one side-dump stone and one bottom-dump, sand, 3-yd. Atlas car; six 3-yd. Austin cars for quarry stone; one Hains concrete mixer; one Ingersoll-Sargeant class-C, 12x18-in. air compressor; seven 90-ft. guyed derricks; five 70-ft., auxiliary-guyed derricks; two traveling, stiff-leg derricks with 50-ft. booms and 25-ft. masts for erecting falsework; six Hains 1-yd., steel, concrete buckets; four 1½-yd. and six 2-yd. Cyclopean, steel, concrete buckets; four flat cars for delivering stone to the bridge.

Mr. Edward P. Casey is the consulting architest, and the bridge is being constructed under the direction of Col. John Biddle, U. S. A., Engineer Commissioner of the District of Columbia, and Capt. J. J. Morrow, U. S. A., and is in charge of Mr. W. J. Douglas, engineer of bridges, and Mr. F. A. Perley, assistant engineer.

Flow of Air in Metal Pipes.

A paper read before the American Society of Heating and Ventilating Engineers, by J. H. Kinealy.

The expression for the friction of the flow of air in metal pipes of a circular or square cross-section may for all practical purposes be taken as

$$F = \left(\frac{v}{5{,}200}\right)^2 \frac{0.3\ l}{d} \qquad (1)$$

In this formula, F is the friction in ounces per square inch; v, the velocity of the air in feet per minute; l, the length of the pipe in feet; and d, the diameter in inches of the pipe if round or the side if square.

If we solve (1) for v we get

$$v = 9{,}500 \sqrt{\frac{d\ F}{l}} \qquad (2)$$

If the pipe is round its area of cross-section in square feet is $0.7854\ d^2 \div 144 = d^2 \div 183$, and if the pipe is square its cross-section in square feet is $d^2 \div 144$.

The product of area of cross-section in square feet multiplied by the velocity of flow through the pipe in feet per minute, is equal to the cubic feet, C, of air flowing through the pipe per minute.

That is, for a round pipe,

$$C = \frac{9{,}500\ d^2}{183} \sqrt{\frac{d\,F}{l}} = 5.2 \sqrt{\frac{d^5\,F}{l}} \qquad (3)$$

and for a square pipe,

$$C = \frac{9{,}500\ d^2}{144} \sqrt{\frac{d\,F}{l}} = 6.6 \sqrt{\frac{d^2\ F}{l}}. \qquad (4)$$

These equations apply only to smooth pipes, and since it is impossible to make in practice pipe which shall be smooth everywhere inside, it is better to say

$$C = \begin{cases} 4.4\sqrt{\dfrac{d^5 F}{l}}, \text{ for a round pipe.} \\ 5.5\sqrt{\dfrac{d^5 F}{l}}, \text{ for a square pipe.} \end{cases} \qquad (5)$$

An inspection of (5) shows that for all practical purposes we may say that the amount of air which will flow through a round pipe of a given diameter and length, for a given value of F, is about 0.8 as much as will flow through a square pipe under the same conditions.

A bend in the pipe tends to increase the amount of friction, and has the same effect as increasing the length of the pipe by an amount which depends upon the ratio of the radius of the middle of the bend to the diameter of the pipe, and upon the diameter of the pipe itself. If we call e this increase in length we may say

$$e = k d \qquad (6)$$

For a 90 deg. bend, where the radius of the middle of the bend is $d \div 2$, k is about 5; and for a 90 deg. bend, where the radius of the middle of the bend is d, k is about 4.

Table I gives the values of k for 90 deg. bends and various values of the ratio obtained by dividing the radius, r, of the middle of the bend by the diameter, d, of the pipe if round, or the side if square.

TABLE I.—VALUES OF k FOR VARIOUS VALUES OF $r \div d$.

$r \div d$	k
½	5
1	4
1½	3
2	2

If we find the equivalent increase of length of a pipe due to each bend, and add this to the length in feet of the pipe, we have what may be termed the equivalent length of the wpipe, hich is always greater than the actual length as measured. Thus, let us suppose we have a square 12-in. pipe, 100 ft. long, which has one square bend and one bend for which the radius of the middle is 18 in., or 1.5 times the size of the pipe, and we wish to know the equivalent length of the pipe.

From Table I we see that k for the square bend, $r \div d$ equals ½, is 5; and for the other bend, where $r \div d$ is 1.5, k is 3.

TABLE II.—CUBIC FEET OF AIR THAT WILL FLOW PER MINUTE THROUGH SQUARE PIPES OF VARIOUS SIZES, 100 FEET LONG, FOR VARIOUS VALUES OF F.

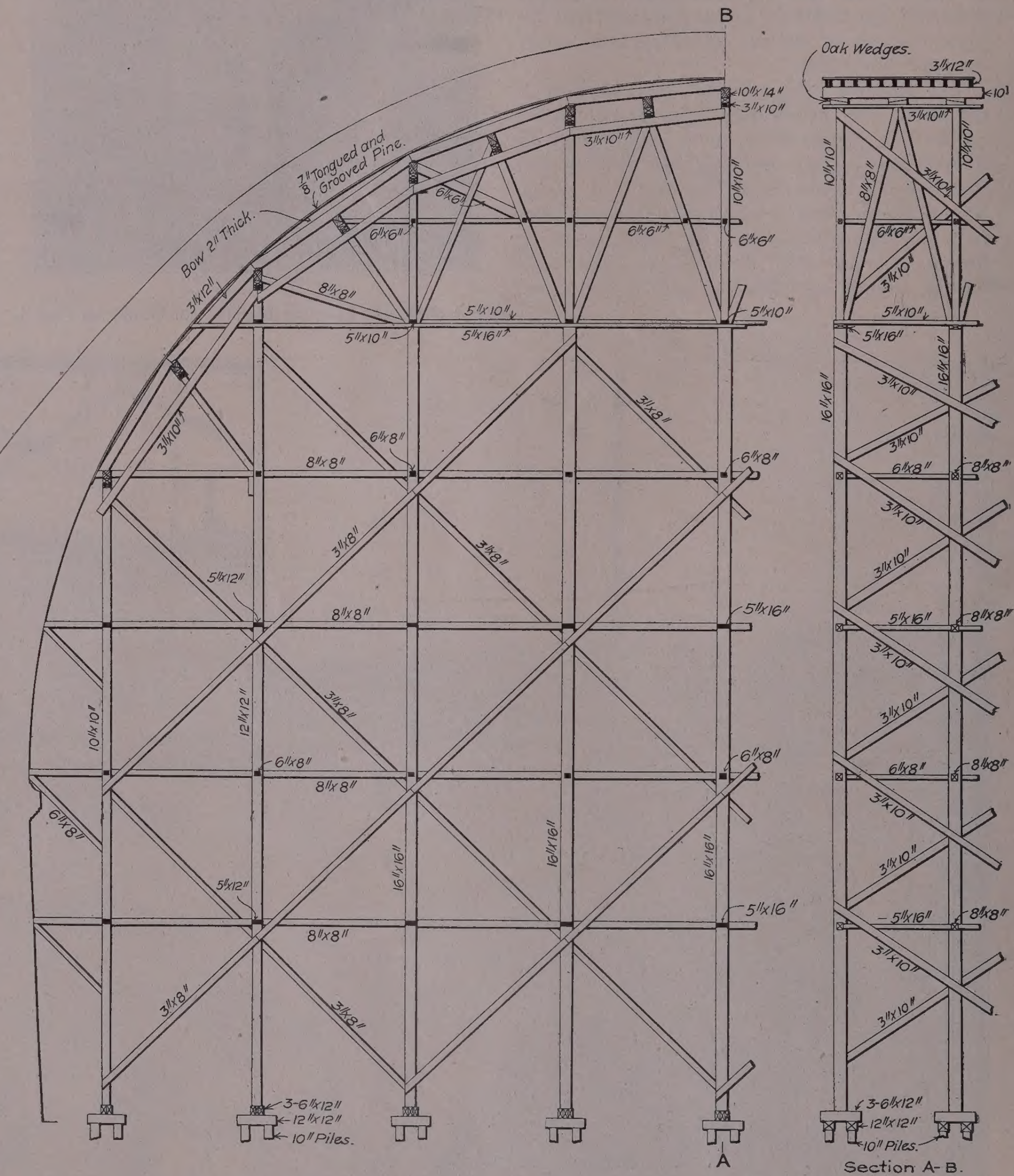
Size of pipe in inches.	F, or loss by friction in ounces per sq. in.						Area of cross-section of pipe in square inches.
	.01	0.2	.03	0.4	0.5	0.6	
6	150	220	270	310	340	370	36
8	320	440	540	630	700	770	64
10	560	780	950	1,100	1,200	1,350	100
12	870	1,200	1,500	1,700	1,950	2,100	144
14	1,300	1,800	2,200	2,600	2,800	3,100	196
16	1,800	2,500	3,100	3,500	4,000	4,300	256
18	2,400	3,400	4,100	4,800	5,300	5,800	324
20	3,100	4,400	5,400	6,300	7,000	7,700	400
22	4,000	5,600	6,900	7,900	11,000	12,000	484
24	4,900	6,900	10,400	12,000	13,000	15,000	536
26	6,000	8,500	12,500	14,500	16,000	18,000	676
30	7,200	10,200	15,000	17,000	19,000	21,000	900
34	11,800	12,200	20,000	24,000	26,000	29,000	1,156
38	15,500	16,600	27,000	31,000	35,000	38,000	1,444
42	20,000	28,000	34,000	40,000	44,000	48,000	1,764
46	25,000	35,000	43,000	50,000	56,000	61,000	2,116
50	31,000	43,000	55,000	62,000	69,000	75,000	2,500

Hence, for the square bend the increase in length is $5d = 60$ ft.; and for the other bend the increase is $3d = 36$ ft. Therefore, the total equivalent length of the pipe is $100 + 60 + 36 = 196$ ft. That is to say, the friction of this 12-in. pipe, 100 ft. long and having the two bends, is the same as it would be in a straight 12-in. pipe 196 ft. long.

It is evident that we may assume various values of d, F, and l in (5) and calculate the amount of air which would flow through the pipe under the assumed conditions.

Table II gives the values of C for various values of d and F for square pipes 100 ft. long, as calculated by (5).

Table II is made for square pipes, but it can be used for rectangular pipes that are not square and also for round pipes. The table may be used for any rectangular pipe whose longest side is not more than twice its shortest. Thus the friction in a rectangular pipe 7x14 in. is only about 5 per cent. more than that in a square pipe 10x10 in. of the same length. As long as the short side of the cross-section of the pipe is not less than one-half the length of the long side, the friction in the rectangular pipe will not be more than 5 per cent. greater than the friction in a square pipe of the same area of cross-section and the same length; and a difference of 5 per cent. is too small to be considered in such work as laying out a system of pipes for a heating or ventilating system.



Centering and Falsework for 150-Ft. Arch.

THE ENGINEERING RECORD.

Main Span Details and Falsework of Connecticut Avenue Bridge.

Table II may be used for round pipes if we remember that the number of cubic feet of air carried by a round pipe of a given diameter and length is 0.8 of the number of cubic feet of air carried by a square pipe of the same length whose side is equal to the diameter of the round pipe. Thus the table shows that the friction of 1,100 cu. ft. of air passing per minute through a square pipe 10x10 in. and 100 ft. long is 0.4 ounce. A round pipe 10 in. in diameter and 100 ft. long would have the same friction if 880, equal 0.8 × 1,100, cu. ft. of air passed through it per minute.

Table II may be used to determine the size of pipe required to carry a given amount of air per minute with a given loss by friction. This may best be made clear by examples.

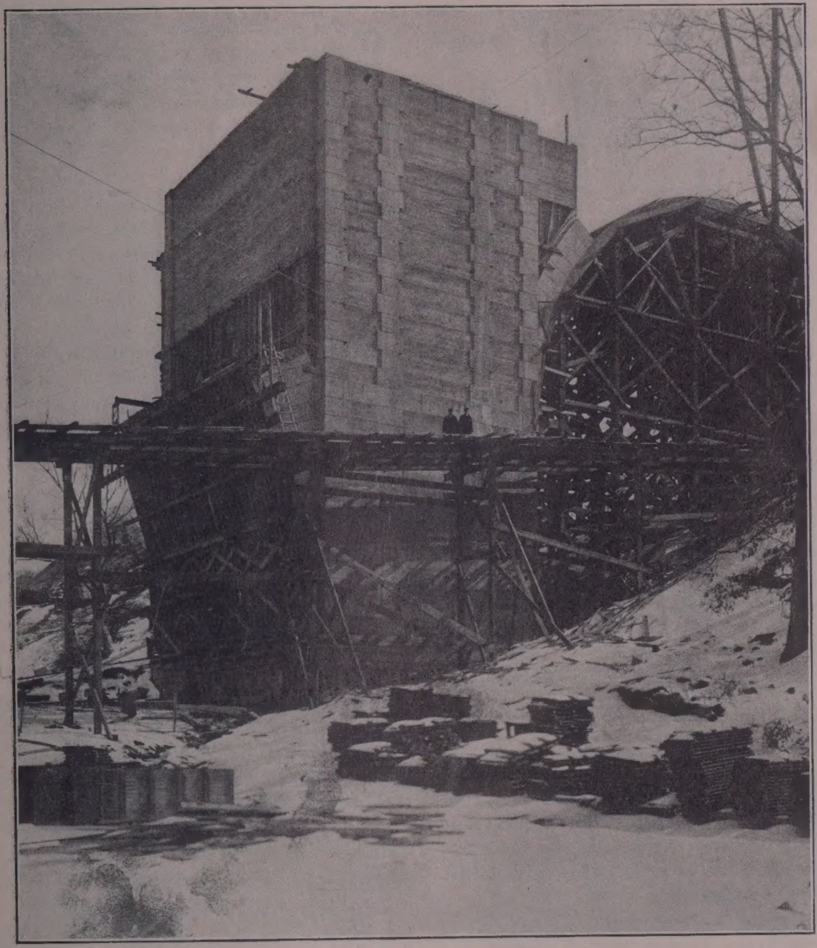
Example 1.—Determine the size of a rectangular pipe required to deliver 3,000 cu. ft. of air per minute a distance of 100 ft. with a loss by friction of 0.2 ounce.

Looking under the column headed 0.2, we find opposite 16 in the first column 2,500; and opposite 18 in the first column we find 3,400. That is, a 16-in. square pipe will deliver 2,500 cu. ft. of air per minute a distance of 100 ft. with a loss by friction of 0.2 ounce; and an 18-in. square pipe will deliver 3,400 cu. ft. of air per minute the same distance with the same loss. Since 3,000 is about midway between 2,500 and 3,400 it is evident that we need a 17-in. square pipe, since it is midway, almost at least, between a 16-in. and an 18-in. pipe.

If we do not want to use a square pipe we proceed as follows: The area of a 16-in. square pipe which will deliver 2,500 cu. ft. per minute is, from the table, 256 sq. in., and the area of an 18-in. pipe which will deliver 3,400 cu. ft. per minute is 324 sq. in. The mean of these is 290, equal $(256 + 324) \div 2$, sq. in. That is, the pipe must have an area of 290 sq. in. to deliver 3,000 cu. ft. of air 100 ft. with a loss by friction of 0.2 ounce. We may use a pipe 12x24, or 15x20, or 16x18 in.

Example 2.—Determine the diameter of a round pipe that will deliver 10,000 cu. ft. of air per minute a distance of 100 ft. with a loss by friction of 0.5 ounce.

Since, as has been pointed out, a round pipe will deliver only 0.8 as much air as a square pipe of the same size with the same loss by friction, if we divide 10,000 by 0.8 we get the amount of air which a square pipe of the same size as the required round pipe will deliver. And 10,000 divided by 0.8 is 12,500.



West Face of Pier I and Lagging for Skewback of 150 Foot Arch, Connecticut Avenue Bridge.

Looking under the column headed 0.5, we find that a 24-in. square pipe will deliver 13,000 cu. ft. of air per minute with a loss by friction of 0.5 ounce. Hence a 24-in. round pipe is what we shall use.

Example 3.—Determine the size of a square pipe required to deliver 1,500 cu. ft. of air per minute a distance of 300 ft. with a loss by friction of only 0.1 ounce.

Since the friction increases as the square root of the length of the pipe, delivering 1,500 cu. ft. of air 300 ft. is equivalent to delivering at a distance of 100 ft. an amount of air equal to 1,500 multiplied by the square root of the quotient obtained by dividing 300 by 100. The quotient obtained by dividing 300 by 100 is 3, and the square root of 3 is 1.7.

Hence the pipe which will deliver 1,500 cu. ft. of air a distance of 300 ft. will deliver 2,600, equal 1.7 multiplied by 1,500, cu. ft. of air 100 ft. with the same loss by friction.

Therefore, we proceed as before, and find the square pipe which will deliver 2,600 cu. ft. of air per minute at a distance of 100 ft. with a loss of 0.1 ounce. This we find must be a 19-in. square pipe, although a pipe 18x19 in. will be large enough.

Example 4.—Determine the size of pipe 150 ft. long with one square 90 deg. bend and two curved 90 deg. bends, required to deliver 2,000 cu. ft. of air per minute with a loss by friction of 0.3 ounce.

In working such an example as this it is usual to assume first the probable increase in the amount of air to compensate for the length and bends, and by practice one soon learns to assume about the proper increase. Here, however, we shall assume no increase at all and proceed as follows:

Delivering 2,000 cu. ft. of air 150 ft. is equivalent to delivering 2,500 (equal 2,000 multiplied by the square root of the quotient obtained by dividing 150 by 100) cubic feet of air 100 ft. And the table shows that for a loss 0.3 ounce a 15-in. pipe will be required. We may assume that for the square bend *k*, given in Table I, is 5; and for each of the round bends *k* is 3. Hence the equivalent length due to the bends is $5 \times 15 + 2 \times 3 \times 15 = 75 + 90 = 165$ ft. The equivalent length of the pipe, therefore, is $150 + 165 = 315$ ft. That is, because of the bends we must deliver the air not 150 ft., but 315 ft. And delivering 2,000 cu. ft. of air 315 ft. is equivalent to delivering 3,600, equal $2{,}000 \times \sqrt{(315 \div 100)}$ cu. ft. of air 100 ft.

From Table II we see that a 17-in. pipe will be required to deliver 3,600 cu. ft. of air a distance of 100 ft. with a loss by friction of 0.3 ounce.

But the equivalent length due to the bends in the 17-in. is $5 \times 17 + 2 \times 3 \times 17 = 85 + 102 = 187$ instead of 165, as assumed. And the equivalent length of the pipe is $150 + 187 = 337$ ft. And delivering 2,000 cu. ft. of air 337 ft. is the same as delivering 3,700, equal $2{,}000 \sqrt{(337 \div 100)}$ cu. ft. a distance of 100 ft.

Table II shows that a 17-in. pipe is not quite large enough, but nearly so, to deliver 3,700 cu. ft. of air per minute a distance of 100 ft. with a loss by friction of 0.3 ounce. A pipe 17x18 would be amply large.

Table II shows very clearly how and why it is that the friction of the flow of air in a round pipe is different from the friction of the flow of air in a square pipe. Thus, suppose we wish to determine the size of a square pipe and also the size of a round pipe capable of delivering 2,000 cu. ft. of air a distance of 100 ft. with a loss by friction of 0.2 ounce.

Turning to Table II we see that a 14-in. square pipe will deliver 1,800 cu. ft. of air a distance of 100 ft. with a loss by friction of 0.2 ounce, while a 16-in. square pipe will deliver 2,500 cu. ft. of air the same distance with the same loss. That is, the 14-in. pipe is slightly too small and the 16-in. pipe is too large. We should use, therefore, a 15-in. square pipe.

To find the round pipe required, we divide 200 by 0.8 and get 2,500. Then we look in Table II and find the size of pipe required, and this will be the size of round pipe required to deliver 2,000 cu. ft. of air a distance of 100 ft. with a loss of 0.2 ounce by friction. From the table we see that an 18-in. pipe will be required. That is, an 18-in. square pipe will deliver 2,500 cu. ft. of air a distance of 100 ft. with a loss by friction of 0.2 ounce, while an 18-in. round pipe will deliver 2,000 cu. ft. of air a distance of 100 ft. with a loss by friction of 0.2 ounce.

In other words, the round pipe must be 18 in. in diameter, while the square pipe need be but 15 in. on the side. The round pipe must be 20 per cent. larger than the square pipe in order to deliver the same quantity of air with the same loss by friction. A round pipe of the same size as a square pipe of a given length will have just exactly the same loss by friction as the square pipe and will deliver only about 0.8 as much air as the square pipe. Further, the round pipe will take up just as much room or space as the square pipe.

A square pipe is better than a round pipe, because it will deliver more air for the same loss by friction and will take up no more space. True, the square pipe will contain more metal than the round pipe, whose diameter is equal to the side of the square pipe, and the square pipe will cost more to make.

The formulas and table given here may be used to lay out all kinds of systems of piping for air, and I hope that the members of the society will find them as useful and convenient in their work as I have.

The State Railways of Germany, having about 30,600 miles of track, are suffering from lack of centralized management. Each State of the Empire runs its railways according to its own notions, although the Constitution provides for centralized management. It is estimated that the needless haul of empty cars, due to the present methods of operation, is 2,500,000,000 car-miles a year, while other faults are delays in shipment, indirect routing and heavy expenses for accounting. The subject is now attracting considerable attention and among the improvements suggested are common ownership of all rolling stock and shops, and a greater approach to uniformity in the construction of new rolling stock. The results attained by centralized management of various properties in the United States has been carefully studied in Germany and seem to be attracting favorable criticism.

Progress in Standardization of Water Analysis in the United States.

The final report of the Committee on Standard Methods of Water Analysis of the American Public Health Association, which was briefly noticed under "Book Notes" last week, contains a historical introduction and a summary of the committee's conclusions that deserve the attention of a wide circle of technical readers. The committee comprises Messrs. George W. Fuller, chairman; George C. Whipple, secretary; H. W. Clark, Edwin O. Jordan, H. L. Russell, J. W. Hellms and Robert Spurr Weston, and they have labored long and patiently at their difficult task.

Proposed Tests for Obtaining Essential Data with Various Types of Water.

	Surface Waters.					Waters before and after treatment by.				Sewages.	
	Clear.	Colored.	Turbid.	Highly Polluted.	Ground Waters.	Sand Filters.	Mechanical Filters.	Softening Plants.	Iron Removing Plants.	Before Treatment.	After Treatment.
Physical Examination.											
Temperature	+	+	+	+	+	+	+	+	+	+	+
Turbidity	+	+	+	+	+	+	+	+	+	o	+
Color	+	+	+	+	+	+	+	+	+	o	+
Tint and Shade	o	+	+	o	o	o	o	o	o	+	+
Odor	+	+	+	+	+	+	+	+	+	+	+
Chemical Analysis.											
Oxygen consumed	o	o	o	o	o	o	o	o	o	+	+
Organic Nitrogen	+	+	+	+	o	o	o	o	o	+	+
Nitrogen as Albuminoid Ammonia	+	+	+	+	+	o	o	o	o	o	o
Nitrogen as Free Ammonia	+	+	+	+	+	o	o	o	o	+	+
Nitrogen as Nitrites	+	+	+	+	+	o	o	o	o	+	+
Nitrogen as Nitrates	+	+	+	+	+	o	o	o	o	+	+
Total	o	o	o	o	o	o	o	o	o	+	+
Residue on Evaporation											
Total	o	o	o	o	o	o	o	o	o	+	+
Suspended	o	o	+	o	o	o	o	o	o	+	+
Dissolved	o	o	o	o	o	o	o	o	o	+	+
Loss on Ignition	o	o	o	o	o	o	o	o	o	+	+
Fixed residue	o	o	o	o	o	o	o	o	o	+	+
Iron	o	o	o	o	+	o	+	o	+	+	+
Calcium	o	o	o	o	o	o	o	+	o	o	o
Magnesium	o	o	o	o	o	o	o	+	o	o	o
Total Hardness	+	+	+	+	+	+	+	+	+	o	o
Alkalinity	+	+	+	+	+	o	+	+	+	o	o
Incrustants	+	+	+	+	+	o	+	+	+	o	o
Chlorine	+	+	+	+	+	o	o	o	o	+	+
Acidity	o	o	o	+	o	o	+	o	+	+	+
Free Carbonic Acid	o	o	o	+	+	o	+	+	+	o	o
Dissolved Oxygen	o	o	o	+	o	o	o	o	+	+	+
Fats	o	o	o	o	o	o	o	o	o	+	+
Putrescibility	o	o	o	+	o	o	o	o	o	+	+
Microscopical Examination	+	+	+	+	+	o	o	o	o	o	o
Bacteriological Examination (Numbers of bacteria.)	+	+	+	+	+	+	+	+	+	+	+
Bacteriolɩ gical Examination (B. coil tests.)	+	+	+	+	+	+	+	+	+	+	+

It is now more than ten years, they report, since there arose in North America a movement for securing the adoption of more uniform and efficient methods for water analysis, particularly of bacteriological methods. Earlier accomplishments related largely to uniform methods of recording chemical results. The late Dr. Wyatt Johnston, of Montreal, was the first one to call the attention of the association to this line of work, and at the Montreal meeting in 1894 the first step in this direction was taken. By invitation of a subcommittee of the Association's Committee on Pollution of Water Supplies, a convention of American bacteriologists assembled in New York in June, 1895, and appointed a committee to draw up procedures for the study of bacteria in a uniform manner and with special reference to the differentiation of species. This committee submitted a report at the Philadelphia meeting of the association in 1897. It was published early in 1898 and has been widely used in various laboratories in this country. The demand for copies of it still continues, although for some time it has been out of print.

At the Minneapolis meeting in 1899 the present committee was appointed, with a view to extending the standard procedures to include not only the determinations of species of bacteria, but all the other lines of investigation involved in the analysis of water. The committee undertook first to ascertain the views of the analysts of America regarding not only the bacteriological, but also the chemical, physical and microscopical examinations of water. Circular letters were sent to all the principal laboratories, and much co-operative work was done in connection with the differentiation of species of bacteria. Progress reports were made at meetings held at Indianapolis, Buffalo and New Orleans, in 1900, 1901 and 1902, the latter two being published in the "Proceedings" of the Association for those years and first in "Science." In 1901 this committee was instructed to revise the 1897 report of the Bacteriological Committee in order to exclude from it those features not found to have been of general service, and to include such new matter as later developments had justified.

In 1902 the committee suffered a severe loss through the death of one of its most valued members, the late Dr. Wyatt Johnston, of Montreal, who is credited by all with the initiation of this movement. Dr. Adolph Gehrmann, of Chicago, resigned from the committee in that year. At the New Orleans meeting the full membership of the committee was restored by the appointment of Mr. R. S. Weston, of Boston, and Mr. J. W. Hellms, of Cincinnati.

The past decade has been a transitional period for water analysis. As this field of sanitary investigation has been extended to cover in a more thorough manner the conditions existing throughout this country, it has been found that the methods applicable to the fairly clear waters of the Atlantic seaboard and to many European waters have not been adequate for the analysis of the muddy waters of the South and West. Conversely, new methods used in certain sections of the country are for similar reasons not always applicable to the conditions existing where the earlier studies were made.

The purification of water supplies has received a great impetus during the past decade, and the water analyst is more and more being placed in charge of the operation of large public filter plants. In work of this character, especially when muddy waters are being treated, he thus uses some methods of analysis which are not generally required for sanitary work; while, on the other hand, he omits with propriety various tests which form an essential part of the customary sanitary analysis.

The presence of objectionable amounts of iron in various ground water supplies and the introduction of special processes for part of the customary removal have in some instances severely taxed the resources of the water analyst, and necessitated modifications of old methods. Methods for determining lead and copper are being used with more frequency than was the case in earlier years, when less attention was given to all the aspects of public health.

Treatment of sewage, to prevent gross nuisances and to prevent pollution and infection of streams, has recently received a marked stimulus through the development of the so-called rapid biological filters, the septic tank treatment, etc. Special tests and analyses have been required in connection with these lines of work—notably those for the determination of the putrescibility of the effents of sewage works. The study of the longevity of disease germs in connection with the question of infection of water supplies drawn from streams at various distances below the discharge of outfall sewers has brought into prominence new lines of bacteriological investigation.

Enough has been said in outline of the new and varied requirements made for the water analyst to show the need of a broad and substantial basis for his methods, and for his work under present conditions. Some of the older methods, used for the study of the general sanitary quality of unfiltered water supplies, are becoming less and less important, while the newer ones, used in the operation of purification plants, are becoming of more value. This is in keeping with the modern tendency of the analyst to become more and more an important factor in connection with the operation of plants for the purification of water and sewage. Indeed, unpurified sources of water supply are becoming fewer and fewer, as hygienic demands are being met by the rapid introduction of purification works, as evidenced by the best practice both in Europe and in America.

The methods of analysis presented in the committees report as "standard methods" are believed to represent the best current practice of American water analysts, and to be generally applicable in connection with the ordinary problems of water purification, sewage disposal and sanitary investigations. Analysts working on widely different problems manifestly cannot use methods which are identical, and special problems obviously require the methods best adapted to them; but, while recognizing these facts, it yet remains true that sound progress in analytical work will advance in proportion to the general adoption of methods which are reliable, uniform and adequate.

It is said by some that standard methods within the field of applied science tend to stifle investigation, and that they retard true progress. If such standards are used in the proper spirit this ought not to be so. The committee strongly desires that every effort shall be continued to improve the technique of water analysis, and especially to compare current methods with those herein recommended, where different, so that the results obtained may become still more accurate and reliable than they are at present.

In the accompanying table are given the more essential determinations which, in the opinion of the committee, should be applied to each of the principal lines of analytical work in connection with the ordinary problems of water supply and sewage disposal. It is realized that some of the older laboratories are hardly in a position at the present time to follow out these suggestions in a literal manner, although on new nork it is believed that they could follow them to advantage.

Plus (+) sign indicates that the test is advised for each type of water under which it appears; while zero (o) indicates that the test is not advised. This table indicates the general views of the committee, and is not intended to limit the use of other tests, either specially or regularly, where the local conditions show such supplementary tests to be desirable. In some instances the tests need not be made on all samples, such, for example, as in the case of dissolved oxygen, and putrescibility of sewage before treatment. The plus signs are here used to show that the information conveyed by these tests should be known to the analyst; and that it is unsafe to assume that all sewages are putrescible or lacking in dissolved oxygen during all hours of the day. Turbidity, free carbonic acid, alkalinity and sulphate contents at intervals are also valuable in sewage work. Free mineral acids and sulphates are important data for surface waters in the coal regions. Tests for lead, copper, tin and zinc are frequently called for in studying the effect of waters upon service pipes. Whenever chemicals are applied to water for any purpose, the results of analyses should record the disposition of the applied chemicals. Water treated by mechanical filters should be tested frequently for acidity; that is, undecomposed, coagulant. Softened waters should be tested for caustic alkalinity in a thorough manner as detailed under hardness.

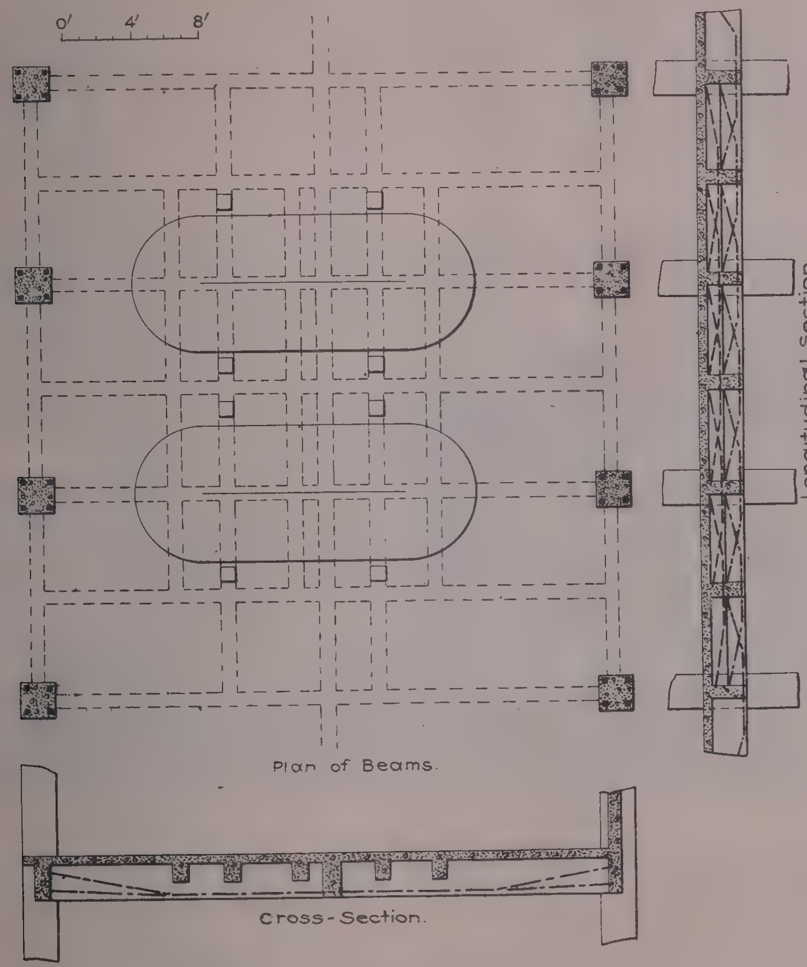
Some of these suggestions may seem radical, and in special instances they may be indeed inexpedient, as already mentioned, but on the whole it is believed that they indicate the lines along which the water analyst may direct his efforts to best advantage and with the feeling that he is obtaining all the data necessary, while doing little or nothing that is needless.

The bacteriological determination, including the tests of Bacillus coli, are given much more prominence than was formerly the case, and that less attention is given to the organic matter as determined by chemical analysis. This is because of the inability of the chemical methods to separate that portion of the organic matter which is of no sanitary significance from that which is associated with pollution or infection.

The most substantial steps in advance relate to improvements in the physical and chemical methods required in connection with the operation of plants for the improvement and purification of water supplies.

A Severe Test of Reinforced Concrete Construction.

A good test of the durability of reinforced concrete construction is afforded in the mill of the Volney Paper Co., of Fulton, N. Y., designed by Mr. D. L. Andrews, of Buffalo. In the beater room on the second floor are eight beaters. This room is 175 x 35 ft. and has a 4-in. floor on 12 x 30-in. beams spaced 6 ft. apart on centers. The floor is reinforced by No. 12 plain twisted fence wire about 3 in. apart, while each beam has four 1¼-in. plain square rods. The roll in each beater weighs 5 tons and runs at 160 r.p.m. Very frequently stock accumulates in wads, throwing these rolls up several inches, and when they come down they break the bars on which they rest.



Arrangement of Girders Under Beaters, Volney Paper Mills.

On the floor above the beater room are the rag cutters which Mr. Walter Bradley, manager of the company, considers the hardest machine on building construction that there is. There are only two knives in the roll, and at 250 r.p.m. they pound continually. Nevertheless he has been unable so far to find any spot or place in the mill that has not been entirely satisfactory.

The walls of the flume are only 2 ft. thick, although they sometimes have to hold back 18 ft. of water. They are reinforced by 1 in. vertical bars 1 ft. apart placed within 4 in. of the outer face. The corners are reinforced by 1½-in. square bars bent to the shape of the angle and placed horizontally 2 ft. apart.

Notes on Reinforced Concrete.

VISINTINI TRUSSED GIRDERS of reinforced concrete are used in the new shops of the Textile Machine Works, of Reading, Pa. They are 24 ft. long, 2 ft. deep and 15 in. wide, and were designed by the Concrete Steel Engineering Co., New York. The floor beams were of the same type and 12 ft. long, 12 in. wide and 6 in. deep. The girders and beams were cast under cover in molds in which the steel reinforcement could be carefully adjusted. The columns in this building are of reinforced concrete also. One of the advantages of the Visintini system is the ability to make the beams in sheds rather than in place.

A REINFORCED CONCRETE FLUME has been designed for the Fort Buford project of the U. S. Reclamation Service. This flume is 136½ ft. long and is supported by two pairs of concrete columns 31 ft. apart, as well as by the natural ground at each end. The flume is 10 ft. wide and 5 ft. deep inside. The walls are 1 ft. thick and have near the inner face ½-in. vertical reinforcing bars on 8-in. centers and 1-in. horizontal bars on 12-in. centers. At the bottom of each wall there are five 1¼-in. longitudinal bars. The bottom of the flume is 15 in. thick and has ¾-in. transverse reinforcement bars on 8-in. centers and 1-in. longitudinal bars on 12-in. centers. In the walls of the headworks, in stream culverts under the canals and other works, reinforced concrete will be used.

CONCRETE PILES of an unusual form have recently been tested in a number of places about New York. They are made by spreading a layer of concrete on wire fabric to which longitudinal rods are attached at intervals. The fabric is immediately rolled up in a special machine of simple construction, and the pile is then laid aside to harden. It thus contains any desired number of vertical rods in addition to the fabric, which, in a cross-section of the pile, has a spiral arrangement from the inside to the exterior of the concrete. If desired, any one of the rods can be a hollow tube so that the water jet process may be used in sinking. This pile is the invention of Mr. A. C. Chenoweth, of Brooklyn, who states that it can be driven by the same machine used with wood piles. He advises placing a cap on the concrete, containing a sand cushion and a short length of wood pile to receive the blow of the hammer. The latter should be heavier and have a shorter drop than for wood piles.

REINFORCED CONCRETE is extensively used on many of the projects of the U. S. Reclamation Service. On the Huntley project in Montana, for example, there are aqueduct flumes for storm water over the main canal, bridge abutments, large inverted siphons under creek beds, and drops and large culverts of this nature under railway embankments. Some of these culverts have only a slight fill between them and the track. One of them, for example, is 4 ft. wide and 3½ ft. high inside, with the sides and bottom 8 in. thick and the top 10 in. The top and bottom are reinforced with ½-in. longitudinal bars on 11-in. centers and ¾-in. transverse bars on 8-in. centers. The former are about 5 in. from the inner face and the latter 2 in. The walls are reinforced by ½-in. longitudinal bars on 13-in. centers and ¾-in. transverse bars on 8-in. centers. The roadway is about 2 ft. above the top of this culvert. In another case, where the cross-section is 8 ft. wide and 5½ ft. high, the side walls are 9 in. thick, floor 9 in. and roof 12 in. at the sides and 14 in. at the center. The roof reinforcement consists of ½-in. longitudinal bars on 12-in. centers and ⅞-in. transverse bars on 6-in. centers. The fill over the culvert is 16 ft.

The Illinois Terminal R. R. Extension.

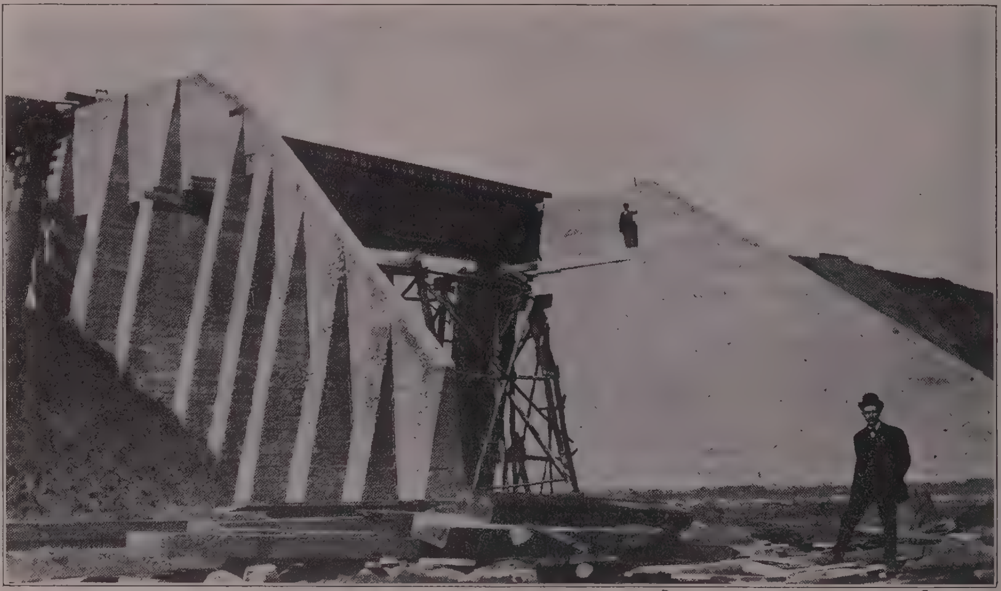
A four and one-half mile extension to the Illinois Terminal R. R. has recently been built connecting that road with the Toledo, St. Louis & Western Ry. and the Litchfield & Madison R. R. near Edwardsville, Ill. The Illinois Terminal R. R. is a belt road connecting the Wabash, the Chicago & Alton, and the Cleveland, Cincinnati, Chicago & St. Louis railroads with the bridge of the Missouri & Illinois Belt & Bridge Co. over the Mississippi River at Alton, Ill.; the extension to it will also connect the Toledo, St. Louis & Western Ry. and the Litchfield & Madison R. R. with the Alton bridge. Although the extension is built over a very rough rolling country its maximum curvature is 3 degrees and the maximum grade on it is 0.65 per cent. All the bridge abutments and other structures on the line were built for two tracks, but only a single track has been laid.

The cuts were made largely with steam shovels and the spoil removed in trains of dump cars operating on temporary tracks. The low allowable maximum grade and several overhead railroad crossings required a number of deep cuts and high fills. The cuts were mostly through clay and hardpan and the fills were made from pole trestles with the dump cars. The railroad crossings and several creek crossings are made on deck plate-girder spans supported on reinforced-concrete abutments.

One of the largest creek crossings is over Cahokia Creek, which has a 60-ft. opening, with deck plate girders 69 ft. long and 7 ft. deep. The reinforced-concrete abutments of this bridge are 46½ ft. high from the bottom of their footing courses to the top of their parapet walls and 121 ft. long from end to end of wing walls. The front faces of the body wall and the wing walls are battered 1 in. in 24 in. to the bottom of the bridge seat, while their back faces are vertical. The body walls under bridge seats are 16 in. thick and 2 ft. 10 in. thick at the base. Each body wall and pair of wing walls rest on a broad monolithic concrete base, 2½ ft. thick, which is heavily reinforced with a horizontal gridiron arrangement of Johnson corrugated bars. Four buttresses, 24 in. thick and battered 3 in. in 12 in. on their back faces, are used to reinforce the body of the abutment and are built directly under the plate girder seats. The foundation is constructed with the same superficial area as would be provided for a solid abutment of plain concrete and the filling back of the body wall rests on this broad base, balancing to a great extent the overturning moment on the abutments. Each buttress is reinforced near its inclined face with twenty-two 1¼-in. corrugated bars placed parallel with its face. Thirteen of the bars run from the base to a height of 16 ft., six bars extend from the base to a height of 26 ft. and 3 of them from the base to the top of the parapet wall. Back of the wing walls are buttresses 18 in. wide, on 7 ft. 3 in. centers, which are reinforced in a manner similar to the reinforcement of the buttresses back of the face walls. Horizontal ½-in. bars are also placed in each buttress in two vertical planes, one near each side of the buttress, the bars on 12-in. centers near the bottom and 18 in. centers toward the top. These horizontal bars are fastened to other horizontal bars, placed longitudinally near the front of the face wall, and are extended back to the rear of the buttresses. The base on which the whole abutment rests is placed on piling driven on 3-ft. centers under the buttresses and near the front line of the face and wing walls. The front row of piles under each abutment was imbedded in a concrete apron wall 3 ft. wide and 10 ft. deep to prevent undermining.

The main line of the Wabash R. R. is crossed with an overhead 103-ft. through plate-girder bridge, with girders 9 ft. deep, build and erected by the Wisconsin Bridge & Iron Co. The bridge has a solid trough floor built up of 15-in. 100-lb. I beams imbedded in concrete, with reinforced-concrete slabs between them. The abutments of this bridge are of reinforced-concrete and are similar in design to those of the Cahokia Creek bridge. They are 28 ft. 1 in. high from the bottom of their footings to the top of their parapet walls, 75 ft. 2 in. long from end to end of wing walls and are built on a concrete base 2½ ft. thick, with an apron wall 4 ft. thick and 5 ft. deep below the base along the front face. The arrangement of the reinforcing bars is practically the same as in the Cahokia Creek bridge abutments. There are but three buttresses back of each face wall, one under each girder seat. These buttresses are 4 ft. 8 in. thick, on 15 ft. centers, with ⅞-in. inclined bars near their back ends.

The St. Louis road is crossed on a 47-ft. deck-plate girder bridge on reinforced-concrete abutments. This crossing is at the foot of a bluff, and a small creek closely parallels the road that is crossed and is carried under the tracks of the extension in a box culvert built in one of the abutments. This arrangement avoided a change in the channel of the creek and the box culvert forms a substantial footing for the reinforcement on the buttresses. The abutments are 31½ ft. high, 96 ft. long, and with the exception of the special design including the culvert in one of them, are built and reinforced the same as the abutments of the other bridges. The culvert has a 10-ft. span and is 10 ft. high above the top of the footing, with a reinforced-concrete slab roof 18-in. thick. This slab is reinforced near its upper and lower faces with transverse ⅞-in. rods on 6-in. centers, with longitudinal ½-in. bars on 24-in. centers just above the lower transverse bars. The outside wall of the culvert is on a footing separate from the footing of the abutment walls and buttresses. Its inside wall is built in connection with a part of the wing walls at either end, but is separate from the face wall of the abutment and the remainder of the wing walls. The buttresses rest wholly on top of the culvert where the inside wall of the culvert and the wing walls are in conjunction. Each of the remaining buttresses rests partially on top of the culvert and is partially carried down to the footing between the face walls and the inside culvert wall.



Reinforced Concrete Abutments of Bridge Over Cahokia Creek.

The concrete was mixed wet in Drake mixers in the proportion of one part Portland cement, 2½ parts sand and 6 parts broken stone. No plastering was done, nor any facing used, the concrete being tamped into place along the forms with spades. This method produced a satisfactory surface that has not been affected by varying weather conditions. The reinforcing bars were held in place until the concrete was laid by wires attached to the forms and the concrete carefully tamped around the bars. Corrugated Johnson bars were used exclusively.

The structures on the extension were designed and most of its construction was carried on under the direction of Mr. T. C. Moorshead, who was at that time chief engineer of the Illinois Terminal Ry. Mr. B. B. Stakemiller, engineer of maintenance of way, is in charge of the completion of the work. The Walsh Construction Co., of Davenport, Ia., was the general contractor for the extension and did all of the work with the exception of the bridges, which were designed and erected by the Wisconsin Bridge & Iron Co., Milwaukee, Wis.

Removing Scale from Condenser Tubes.

Condensed troubles in refrigerating plants, due to the scaling of pipes, have been remedied in a simple manner by Mr. A. P. Anderson, of the Consumers' Ice Co., Chicago. The condensing water is often impregnated with mud, alkali, magnesia and other substances, which are baked on the pipes by the heat of the compressed ammonia gas or steam within them. This scale is generally pounded off the pipes with a hammer, which is an expensive and destructive method. Mr. Anderson has surmounted the difficulty by using a size F Boyer pneumatic hammer, made by the Chicago Pneumatic Tool Co. This hammer strikes rapid, uniform and light blows which remove the scale instantly without any danger of cracking the pipes and fittings. The condensers have to be shut down but a short time, owing to the rapidity with which the work can be done.

THE ELECTRIC HAULING OF TRAINS on the Metropolitan Ry. of London will shortly commence, as the British Westinghouse Co. has begun the delivery of the 50-ton electric locomotives for the purpose. Steam locomotives will handle the trains between Aylesbury and Harrow, and the others between Harrow and Baker St. The same locomotives will be used on the Metropolitan half of the Inner Circle for freight traffic and the trains of other companies having running rights over it.

The Selection of Water Works Pumping Machinery.—I.

By Nicholas S. Hill, Jr., Consulting Engineer, New York.

The failure to introduce the best modern power-station practice into the design of municipal and other pumping plants is worthy of comment. The efficiency of pumping engines and their trial duty has steadily increased during the past fifteen years. Improvements in design, with a decided tendency to reduce the number of working parts, are being constantly made, with resultant economy in cost of operation and maintenance. The builders of pumping machinery have abandoned former ideas of "special" design. The fact that a pumping engine differs from other engines only in the application of its power directly to the pump plunger in place of the shaft of a dynamo, propeller shaft or belt wheel is realized as never before. The conditions of constant load under which many pumping engines operate are conducive to economy in coal and steam consumption.

Station Duty.—The results obtained from trials of the highest types of pumping machinery, expressed in foot-pounds duty per 1,000 lb. of steam or 1,000,000 heat units, show a corresponding coal consumption per horse-power per hour equal to the best class of stationary or marine engines. The low station duty frequently found in operation cannot, therefore, be fairly attributed to the engine builders. In fact, the majority of engines purchased at this date are furnished by responsible companies, and the knowledge of their duty performance under given conditions is quite general, so that the pumping unit, considered singly, is economical and efficient. The departure from the best practice in modern power stations must be looked for in the boiler plant, the general arrangement of machinery, steam-piping details, utilization of waste heat, and the efficient design of auxiliaries. All of these elements enter into the station duty, which is the final and economic measure of the operation of the plant. The absence of proper engineering supervision and care in maintenance is noticeable in many municipal plants. It is not reasonable to expect under such conditions a continuance of an engine duty equal to that developed on trial when each part of this unit is in perfect condition and adjustments all properly made.

The usual depreciation of every part of the plant, due to operation, affects the station duty. Many engineers place too much value upon the trial engine duty. The engine duty represents only the efficiency of the engine. This is one and a very important item embraced in the cost of pumping. The effectiveness of the remainder of the plant is of equal consequence. The fixed charges, including interest, depreciation and refunding, together with the expenses for maintenance and attendance, must be added to obtain total cost. An engine, therefore, may develop a high duty and be economical, as a unit, in the consumption of coal, while the station duty is relatively low, and the cost of pumping higher than expected from the effectiveness of the pumping machinery. There is no reason, however, for a plant to maintain in operation less than 85 per cent. of the engine and station test duty.

Engine Duty.—Duty is the measure of efficiency usually used in considering pumping plants or pumping machinery, and is the ratio of work done to the energy expended in doing it. Duty is usually expressed as the ratio of the weight of water pumped times the head pumped against (or foot pounds) to a fixed weight of coal, or steam, or to a fixed number of heat units used. The terms generally employed at present are foot-pounds, duty per 1,000 lb. of steam or per 1,000,000 heat units (B.t.u.). Formerly duty was based on foot-pounds per 100 lb. of coal. If the last-named basis is used, the plant efficiency must also be included, and may correctly be termed the station duty. It embraces boilers, steam pipes, feed pumps, heaters, etc., which have not necessarily any relation to the individual efficiency of the pump. It is the commercial test to be used in daily operation. It should be used if the engine builder is required to furnish boilers, heaters, piping, economizers, foundations (sometimes even auxiliary lighting plants), and every other conceivable device which he does not manufacture. This practice, which is to be deplored, is not in accord with custom in the erection of other power plants.

Separation of Contracts.—The builder of pumping machinery should be only required to erect the engines complete, with condensers and attached auxiliaries, on foundations supplied by the purchaser. If, however, he is called upon to furnish other machinery, he should be made responsible for the efficiency of the entire plant, in order to stimulate the same attention to details and the proper design of the boilers, piping and other equipment that is given to the engines. The contracts should be so let that the buildings and foundations, stack, engines, boilers, piping, economizers and other machinery are obtained from contractors especially equipped in their various lines.

In the event the work is properly divided, the engine builder should guarantee only the efficiency of the pumps, condensers and attached auxiliaries, and the duty required should be expressed in terms of the steam or heat units consumed by the engine in accordance with the rules formulated and approved by the Am. Soc. M. E.

The boilers, economizers, superheaters, and other machinery installed should be bought under a specification prepared by an engineer, and a proper guarantee of efficiency made by their manufacturers, and tested independently, to determine whether the guarantees are fulfilled.

The steam and water piping should receive particular attention in connection with the general arrangement of the machinery, to avoid unnecessary lengths of piping, and to reduce the number of bends to a minimum. Specifications should be especially prepared, augmented by complete detail drawings, showing the location of all pipes, and the location and number of joints, bends, valves, etc. Provision should be made for the necessary drips and drains to return the condensation to the boilers, and durable and efficient covering should be specified for all steam piping.

My experience leads me to the firm conviction that the municipality or company building or increasing a pumping station will save money by having the proper specifications prepared preliminary to letting contracts, and assuming responsibility for the parts of the plans which it is not the province of the engine builder to provide, and which he cannot furnish without an element of uncertainty as to cost, which redounds to the disadvantage of the purchaser on account of percentages added by him to cover possible contingencies of which he cannot accurately inform himself in advance.

Confused Specifications.—The practice of drawing voluminous, detailed and redundant specifications for pumping engines adds, in many instances, to the first cost of a plant without apparent advantage to the purchaser. Some specifications confuse bidders, and obscure the intentions of the purchaser, producing uncertainty with regard to the interpretation of many clauses which might affect the cost of machinery, and hence invoke increased prices. A simple, lucid, succinct specification is productive of economy in first cost, and, in the judgment of the writer, procures more efficient machinery. Specifications, however, should be sufficiently precise to stipulate the type of pump desired, to place, so far as practicable, all bidders upon an equal footing, and to fix all the essential details of construction and operation, together with the necessary guarantees of efficiency, under the conditions specified.

The object of the specification is to obtain a uniform basis for bidding, maximum efficiency commensurate with a reasonable first cost and interest account, minimum cost for maintenance, durability and proper capacity, together with the necessary auxiliaries and appurtenances to secure a complete pumping unit. If the contractor, therefore, is needlessly limited in the matter of detail, he will be required to provide special designs, which may or may not (probably the latter) prove economical, and which will tend to increase materially the initial investment without effecting a proportionate decrease in the expense of operation. I do not believe that any benefit accrues by limiting the pump builders with regard to the minor details of construction. The different manufacturers vary their practice somewhat in this regard, but the net result is not affected by the variation in the design of such details of the engine, so long as the engineer retains the power to examine, and finds that the essential parts of the engine are properly constructed. If the proper latitude is allowed the several responsible pump builders in submitting designs, they may avail themselves of patterns and parts which have already been constructed by them and tried in service, and are suitable to the conditions under which machinery may be bought.

The following brief outline indicates the essential features to be covered by a specification, which may be modified to suit special conditions:

General Form for Pump Specifications.

Work to be Done.—Furnish all labor and material, design, build and erect ——— gal. (high-duty) pumping engine, with all appurtenances, on foundations furnished by ——— in the engine room at the ——— pumping station of the ——— located at ———.

Dimensions.—The pumping engine shall be of modern construction in every detail, and of such dimensions as to easily perform the work herein called for, without undue strain or injury to any part.

Ornamentation.—The external finish shall be neat and attractive in appearance, but not necessarily ornate, nor replete with polished surfaces which will require undue labor to keep bright.

Foundations.—Will be built by (city or company) purchaser, but the contractor shall furnish detailed drawings of the same, together with templates and foundation bolts.

To Submit Drawings.—The contractor shall submit, with his bid, detailed specifications and drawings, giving the principal dimensions of the pumping engines, complete in place in the engine room. Before the work is commenced, detailed plans and drawings for all parts of the work shall be submitted to the engineer, in duplicate, for his approval, one copy to be retained by the engineer, and the second to be returned to the contractor. All plans and drawings submitted by the contractor shall, after approval by the engineer, become a part of these specifications.

Upon completion and acceptance of the work, the contractor shall furnish two complete sets of working drawings (or blue prints of the same on cloth sheets) of a uniform size to correspond with the standard sizes of drawings of the (purchaser).

Obstructing Material.—The contractor shall at all times keep the engine room free from unnecessary obstructing material.

Space Available.—The pumping engine shall be located in engine room, as shown on drawings furnished by (purchaser).

Conditions of Erection.—The engine may be unloaded from car at door of engine room within ——— ft. of foundations. The station is (will be) equipped with a travelling crane of ——— tons capacity.

Note.—The above sample will illustrate the conditions which should be named in this clause. If no crane is to be installed, statement should be made that contractor is to furnish necessary cranes and derrick, etc.

Suction and Delivery Lines.—The purchaser (city or company) will furnish and install the suction and delivery lines complete with all valves, fittings and connections, except check valve in delivery of (each) engine.

General Data, Elevations.—Ground level, elevation engine room floor, elevation basement floor, elevation water in receiving basin (intake), static head at level engine room floor, allowance added for friction in force main, delivery head, suction lift, steam pressure at throttle

Source of Supply.—Indicate in this paragraph the manner in which water is to be obtained, and from where pumped, intake from river or pond, receiving basin, mains or conduit, etc., etc.

Manner of Delivery.—The pump shall discharge into (city service mains), (force main ——— long ——— diameter to reservoir or stand pipe), etc., etc.

Conditions of Operation.—(Each) engine may be required to run continuously, day and night, to supply the demand, which may vary from ——— gals. to ——— gals. per minute.

Type of Engine.—The engine(s) shall be of the (horizontal, vertical), (compound, triple expansion), (direct acting, crank and fly wheel), having (double) acting (outside) packed plungers.

Stroke and Plunger Speed.—The stroke shall not be less than ——— in., and the plunger speed shall not exceed ——— ft. per minute.

Condenser.—(Each) engine shall have (an independent or attached jet condenser) a surface condenser in the discharge line.

Air Compressor, Vacuum Pump and Boiler Feed Pump.—An air compressor for charging air chambers, a vacuum pump, and a boiler feed pump shall be attached to (each, the) engine.

Note.—If independent auxiliaries are preferred, they may be specified, and this clause eliminated.

Capacity of Engine.—When operating at a plunger speed which shall not exceed ——— ft. per minute (each, the) engine(s) shall be capable of delivering easily not less than ——— U. S. gals. of water in 24 hours against a head of ——— ft.

Guarantee of Capacity and Duty.—The contractor shall guarantee that (each, the) engine shall have a capacity as specified in the preceding paragraph, and that it shall perform a duty of ——— ft.-lbs. of work for each 1,000 lbs. of commercially dry steam used by the engine, and all auxiliary pumps supplied by the contractor or operated by the contractor during the duty trial. If superheated steam of ——— deg. Fahr. temperature is used, the engine shall perform a duty of ——— ft.-lb. for each 1,000 lb. of steam used for the engines and auxiliaries.

Time of Duty Trial.—The duty trial will be made at such time, after the erection and completion of the engine, as the builders may select, provided the engineer shall have received at least two weeks' notice in advance.

Computing Duty.—(a) In computing the duty, the work performed by the engine shall be based upon plunger displacement. The head for computing the duty shall be that shown by an accurate pressure gauge attached to the discharge main at a point beyond the common nozzle on the pump, plus the difference in elevation between the water in the suction well and the zero mark on the said gauge. No allowance shall be made for the friction of water in the pumps or pipes between the suction tank and the gauge attached to the discharge main. (b) In computing the duty, the total steam used by the jackets, reheaters and auxiliary pumps shall be charged to the engine.

Length of Duty Test.—(a) The duration of the duty trial shall be ——— hours. The engine shall be operated continuously, at its rated capacity against a total head of ——— ft., and shall be supplied with steam at not more than ——— lb. pressure per square inch by gauge at the throttle valve. (b) The duty test shall be conducted so far as practicable, in accordance with the standard rules adopted by the Am. Soc. M. E. The suction and delivery valves, and pump plungers shall be practically tight, and test for the tightness of same satisfactory to the engineer shall be made. (c) During the official trial, the engine shall be operated by the regular enginemen of the station, at the speed and pressure specified, but otherwise shall be under the control of the contractor. The trial shall be conducted jointly by the engineer and a representative of the contractor, and in case of disagreement, or by mutual consent of the engineer and contractor, they shall select a third party whose decision shall be final.

Expenses of Duty Test.—The purchaser shall bear all expenses of the test, except that the contractor shall pay his own expert; and in case of the appointment of a third expert, the expenses of employing him shall be shared equally by the purchaser and the contractor.

Bonus, Deduction or Rejection on Account of Duty.—If the duty shown by the official trial of each engine using commercially dry steam shall exceed ——— ft.-lb. of work, the purchaser will pay the contractor the sum of ——— dollars for each ——— ft.-lb. of work performed in excess of the guaranteed amount, not to exceed ——— dollars. If the duty shown by the official trial of each engine is less than ——— ft.-lb of work, the purchaser will deduct from the amount to be paid the contractor, the sum of ——— dollars for each ——— ft.-lb. of work unperformed below ——— ft.-lb. of work. If the duty shown by the official trial of each engine shall be less than ——— ft.-lb. of work, the engineer may, at his option, reject the engine, and in case of such rejection, the contractor shall return all moneys paid him on account, and shall, without compensation, allow the engine to remain in the service and under the control of the purchaser for such reasonable time as may be required to install a new engine.

Note.—This clause may be omitted at the option of the purchaser.

Endurance Trial.—In addition to the above duty trial, and in order to determine its durability, each pumping engine shall be run at its rated capacity for a period of not less than 50 days without breakdown or stoppage on account of defects in the machinery.

Handling.—The engine(s) shall be of a type such that they (it) may be easily handled without the use of skilled labor, and that they may be stopped or started with promptness by an ordinary engine tender.

Hand Holes.—All hand holes shall be of ample size, and so constructed as to be readily opened and closed, and where necessary, be provided with cranes.

Safety Devices.—Ample safety devices shall be provided to guard the engine against accidents in case of a sudden decrease in pressure, such as would be caused by the bursting of a water main or otherwise. While under normal conditions the speed must be regulated so as to maintain a uniform water pressure.

Check and Relief Valves.—A check valve should be provided in the discharge pipe of each engine. A relief valve and pipe of sufficient capacity to admit of starting up the engine easily, and to take the pressure off the engine when at rest shall be provided.

Pressure Tests.—The pump cylinders and the discharge connections shall be subjected to a hydrostatic test of 150 lb. per square inch after being put in place, and the suction pipes and chambers to a pressure of 50 lb. per square inch; and under these conditions all joints and castings must be absolutely tight and free from leakage.

Note.—The above pressure is sufficient for all ordinary heads pumped against.

Balance.—The steam distribution in the cylinders shall be such as to give practically equal steam cards from each end of the stroke.

Clearance.—It is difficult to fix a general specification for clearances expressed in percentages of cylinder volumes. The cylinder volumes materially affect this ratio, being higher with small cylinders, and the reverse with large cylinders. The clearance is also affected by the type of valve used, and if the clearance specified is too low, the builder may be limited in his selection of the valve gear. Sometimes the advantages of a very low clearance are offset by other disadvantages in the type of valve required. Generally, a rigid duty specification will necessitate the introduction of a proper valve gear with a clearance as low as practicable. Clearances in large units have been known as low as follows:

High-pressure cylinder	1.4 per cent.
Intermediate cylinder	.6 per cent.
Low-pressure cylinder	.5 per cent.

The amount of clearance in single cylinders with Corliss valve gear is from 2 to 3 per cent., with ordinary slide valves 5 to 10 per cent.

Steam Jackets and Reheaters.—The steam cylinders shall be thoroughly steam jacketed. The construction and arrangement of the steam jackets shall be such as to prevent undue strains from shrinkage or unequal expansion.

The re-heaters shall be constructed with copper coils, having ample heating area. They shall be tested to insure absolute steam tightness under any pressure to which they may be subjected in operation.

Provision shall be made for the proper means of examination, and for repairs and renewals. They shall be of liberal dimensions to prevent distortion in the steam distribution, to preserve the most economical temperature of the working steam at the pressures in the different cylinders, and to avoid the induction of superheated steam to the condenser.

Note.—If superheated steam is used, the steam jackets may be omitted.

Area of Water Passages.—When the pumps are each delivering at the rate of ——— gals. per 24 hours, the velocity of the water through the pump valves or suction pipe, or any of the passages in the pump shall not be in excess of 3 ft. per second, and at the point of delivery must not be in excess of 3½ ft. per second.

Metallic Packing.—All piston rods and valve stems shall be packed with metallic packing, approved by the engineer.

Covering.—The steam cylinders, re-heaters and steam pipes shall be covered with 85 per cent. magnesia, of a thickness not less than 3 in., and wherever practicable, shall be protected by a substantial steel or iron lagging, neatly fitted and applied, so as to be easily removable. When it is not practicable to apply lagging, the covering shall be protected by heavy cotton duck, carefully and neatly applied.

Stairway and Platforms.—When necessary, suitable platforms and galleries, at convenient locations, shall be provided upon the pump and steam ends to facilitate the operation and maintenance of the engine. Necessary stairways to give access to the platforms and galleries shall also be provided.

Note.—If vertical engines are specified, a suitable bridge or walk should be specified to connect the top galleries.

Inspection Before Painting.—All castings shall be inspected and approved before painting, and in no case shall the paint or oil be applied until all surfaces are trimmed and thoroughly cleaned.

Painting.—The interior of the pumps and all other surfaces exposed to the action of cold water shall be coated with three coats of approved paint. All iron work which is lagged shall have two coats of red lead in pure linseed oil. All other unfinished iron work shall be cleaned, and have one coat of pure iron oxide at the shop. After the completion of the engine at the pumping station, all visible unfinished iron work shall be rubbed down and painted with three coats of paint and pure linseed oil; the paint and color shall be approved by the engineer.

Condenser.—Each engine shall be provided with a surface condenser, arranged in the discharge main, of appropriate size, design and construction, and guaranteed to maintain a steady vacuum of not less than 27 in. of mercury, and so designed as to give ample facility and space for the examination and inspection of the interior. The condenser shall safely stand all working stresses to which it may be subjected without leakage of any description.

Note.—Jet condenser may be specified in this paragraph.

Tools, Gauges and Appurtenances.—The contractor shall furnish all necessary foundation bolts, plates and templates; a set of wrenches, spanners and tools for all nuts and bolts on all parts of the pumping engine(s), and a substantial rack for holding them, engine indicators of an approved make, with electrical attachment for operating the same, and a permanent and substantial indicator gear arranged for taking diagrams from the steam cylinders and main pump; drip pans for collecting grease and water from all stuffing boxes, rods or surfaces where condensation is formed on the exterior, with connections to sewer or other suitable drain; a steam gauge connected with the steam pipe between the throttle valve and the engine; a steam gauge connected with the receiver; a vacuum gauge with the exhaust pipe near the engine; a water gauge connected to the discharge pipe near the engine. These four gauges shall be suitably mounted on a metallic plate, and provided with petcocks or valves, to blow off the gauge connections.

With each engine shall be furnished a recording steam gauge connected with the steam pipe near the throttle valve; a recording water gauge connected to the delivery pipe; a mercurial thermometer attached to the steam pipe, between the throttle and the engine; a revolution counter connected to the engine in a simple and reliable manner; an attached oil pump for lubricating steam valves and cylinders.

The provisions for oiling the bearings should be such as to secure minimum labor on the part of the attendants, and wherever practicable, grease cups or oil cups should be provided with sufficient reservoir capacity so as to not require filling more than once a day.

Each air vessel or vacuum chamber connected with the discharge or suction of the pump shall be provided with glass water gauges to indicate the height of water in the chambers.

Pipe Connections.—The contractor will be required to connect the suction and delivery piping furnished by the purchaser to the suction and delivery connections on the pumping engines.

Bearings.—All journals, cross heads, slides and wearing parts of the valve motion shall be fitted with adjustable bearings, and lined with best anti-friction composition metal, and arranged for proper lubrication. Specimen of anti-friction composition metal shall be submitted to the engineer.

Cast Iron.—The castings shall be made of a tough gray iron, which shall exhibit a uniform and closely grained fracture, free from any white, mottled or vitreous appearance. A blow from a hammer shall produce an indentation in the rectangular edge of the castings without flaking the metal. All cast iron for steam cylinders, steam distributing valves, barrels of air pumps and water plungers, shall have a tensile strength of not less than 22,000 pounds per square inch. Test bars of 1-in. section and 40 inches in length, when placed upon sharp edged supports 36 inches apart, shall sustain at the middle point a gradually applied load of 750 pounds, with a deflection at the centre of from 0.55 to 0.65 of an inch. The cast iron required for all other portions of the work shall show a tensile strength of not less than 18,000 pounds per square inch. Test bars, similar in size and arrangement to those just described, shall sustain at the middle point a gradually applied load of 700 pounds, with a deflection at the centre of from 0.4 to 0.5 of an inch.

Cast Steel.—All the cast steel furnished shall be free from blowholes, true to pattern and properly annealed; the castings shall have a smooth and workmanlike finish. Test bars having a sectional area of at least one-half square inch shall show the following requirements:

Ultimate strength of at least 70,000 lb. per square inch; elastic limit of at least 35,000 lb. per square inch; elongation of at least 16 per cent. in 8 in., reduction of area at a point of fracture of at least 18 per cent.

Wrought Iron.—All wrought iron used shall be of the best grade of American double refined iron, and must be tough, ductile, fibrous and of uniform quality, properly welded, smooth and free from cinder pockets or injurious flaws, buckles, blisters or cracks. Test pieces of the material when used for rods, bolts, clamps, keys or similar parts, shall show the following requirements:

Ultimate strength of not less than 52,000 lb. per square inch; elastic limit of not less than 26,000 lb. per square inch; elongation of at least 18 per cent. in 8 in. on bars having a sectional area of one-half square inch. The iron must be capable of being bent cold, 180 deg. about a curve whose diameter is equal to the thickness of the piece tested, without showing signs of fracture. The material for forgings and the method of working shall be satisfactory to the engineer.

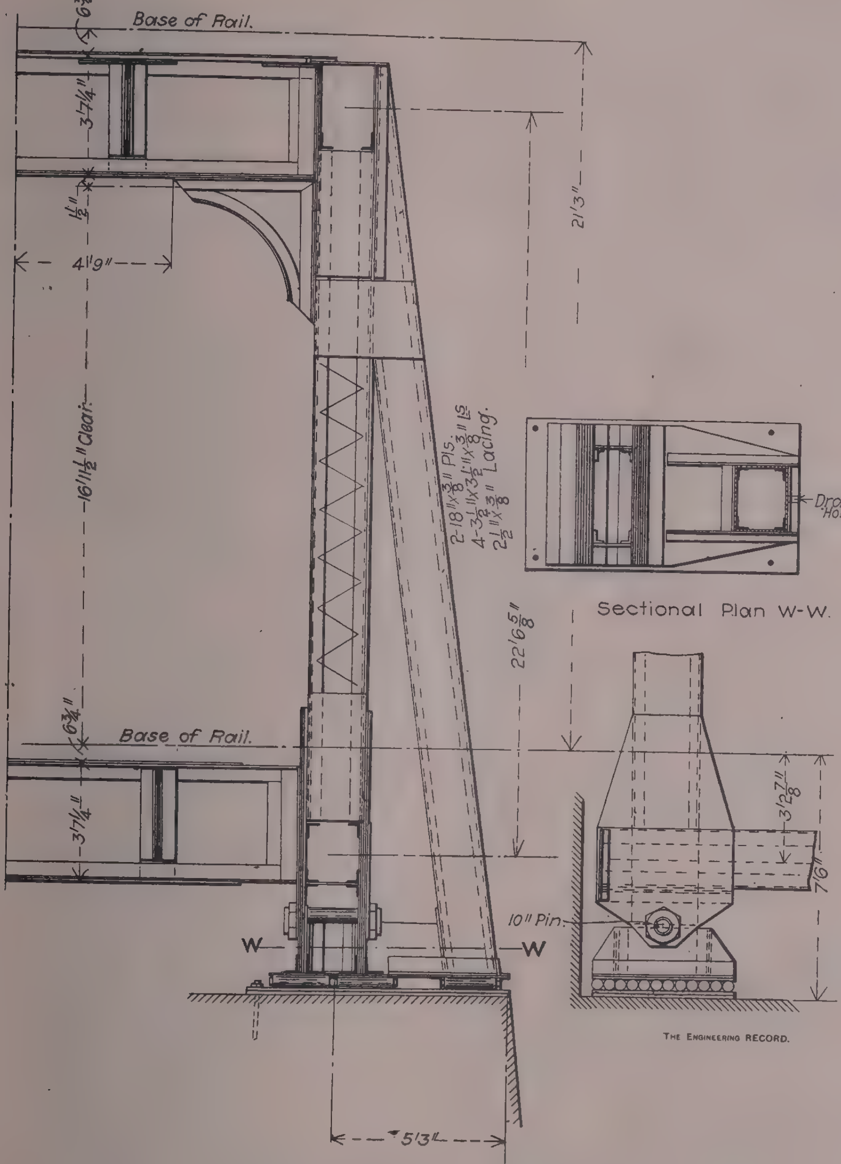
Steel Forgings.—Principal forgings, such as crank shaft connecting rods, piston rods, plunger rods, crank pins, etc., shall be made of open hearth, fluid compressed, carbon steel, having a tensile strength of not less than 75,000 lb. per square inch, and an elastic limit of not less than 37,500 lb. per square inch, and elongation in 2 in. of not less than 25 per cent., and a contraction of area of not less than 35 per cent. In chemical composition the amount of phosphorus or sulphur in the metal shall not exceed 0.06 of one per cent. each, manganese 0.60 and carbon 0.25 to 0.40 per cent.

Steel Physical Properties, Tensile Test, etc.—All principal forgings shall be hydraulically forged (not hammered), and where possible they shall be either forged hollow or bored to remove any possible piping. Minor forgings shall have a tensile strength of 70,000 lb. per square inch, and an elastic limit of not less than 35,000 lb. per square inch. All forgings shall be free from welds and thoroughly annealed before machining.

Finish. — Forgings shall be free from cracks, flaws, seams or other injurious imperfections, and shall be made and finished in a workmanlike manner.

Bending Test.—A specimen bar 1 in. by ½ in. shall bend cold 180 deg. around a diameter of 1 in. without fracture on outside of bent portion.

Number of Test Bars.—From one of the principal steel forgings made from each heat or run of metal, the contractor shall furnish at least two standard turned test specimens, ½ in. in diameter, and 2 in. gauge lengths, and two bending specimens, 1 in. by 1½ in. These shall be cut cold from the forging, or the full-sized prolongation of same parallel to the axis of the forging, and half way between the center, or, in case of hollow forging, half way between the inside and the outside surfaces. The specimens to be longitudinal, *i. e.*, the length of the specimens to correspond with the direction in which the metal is most drawn out or worked. Should this set of test bars show that the metal has the required properties, as herein specified, then all other forgings made from the metal of this melt or heat will be accepted without further testing.



Braced End Post of Through Span of Double Deck Railroad Bridge.

Sample of Chemical Analysis.—For the chemical analysis turnings from the tensile specimens or drillings from the bending specimens, or from the ingot itself, may be used. The analysis and tests will be made by the purchaser.

Best Materials.—All materials used in the entire work shall be of the best of their respective kinds, and best adapted for the particular service of each part.

Intent of Specifications.—It is the intention of these specifications to call for the erection of ———— substantial ———— million-gallon (high-duty) pumping engine(s) of modern construction in every particular, with all connections, appurtenances, fittings and tools necessary for the operation of the same, the whole to be erected complete in place and ready for regular service.

Patents.—The contractor shall employ no patented method of construction, nor furnish any appliance, the operation of which is patented, except such methods or appliances as are either owned or controlled by him. He will hold himself responsible for any claims made against the purchaser for any infringements of patents by the use of patented articles in the construction and completion of the work, and the purchaser shall be and is hereby authorized to deduct and retain out of the moneys which may be due, or may become due to the contractor under this contract, a sum sufficient to cover all claims for damages arising from such infringement, and to retain the same until the settlement or other disposition of said claims.

Explanations.—Any doubt as to the meaning of these specifications, or any obscurity in the wording of them, will be explained by the engineers, and all directions and explanations requisite or necessary to complete, explain or make definite any of the provisions of these specifications, and give them due effect, will be given by the engineer.

Responsibility for Machinery.—The contractor shall be responsible for the safety of the engine furnished under this specification until its final acceptance, and replace any parts injured during construction or test.

Damage to Property and Persons.—The contractor shall reimburse the purchaser for all damage to the property of the purchaser or others caused by his agents or employees, or due to the work of the contractor, and he shall be responsible for all injury to the person of others.

Time of Completion.—The contractor agrees to complete the work herein specified within ———— working days from the date of the acceptance of his (their) proposal.

(To be continued.)

A Double-Deck Railroad Bridge with Braced End Posts.

In the Passaic River bridge of the Delaware, Lackawanna & Western R. R. at Newark, N. J., the approach span at each end of the draw span is a double-deck structure carrying two passenger tracks at top chord level and one freight track at bottom chord level. The riveted Pratt trusses are 103 ft. 5⅞ in. long, 22 ft. 6⅝ in. deep and 19 ft. 6 in. apart on centers. The freight track enters the span at a 12° curve, the outer rails of the passenger tracks are almost in the planes of the trusses, and it was considered desirable to give the trusses increased lateral stability. This was accomplished by bracing the tops of the vertical end posts with batter posts in the same transverse planes as indicated in the balf-end elevation.

The top and bottom chords have rectangular cross sections made of plates and angles, and are continuous beyond the end vertical posts, which are cut to clear them and are connected to them by wide and thick gusset plates. These gusset plates project below the lower flanges of the bottom chords and form shoes with half-hole bearings for the 10-in. end bearing pins, which are seated in ordinary riveted pedestals, fixed at one end and moving on expansion rollers at the other end. The batter posts have cross sections corresponding to the vertical posts, built up with two 18x⅜-in. plates and four 3½x3½x⅜-in. angles, providing a total cross-section of 23½ sq. in. and providing for a maximum stress of 244,000 lb.

The upper ends of the batter posts are beveled and rigidly connected to the vertical posts. The bottom of the batter post projects about 5 ft. below that of the vertical post and is riveted to the wide base plate of the pedestal for the end pin. At the expansion end these plates are seated on two separate sets of rollers, the one under the pedestal engaging the usual guide ribs on the base and bed plates, and the one under the batter post having no guide rib, but being retained between two longitudinal side angles riveted to the base plate and just clearing the bed plate. The bridge was designed and constructed under the direction of the engineering department of the railroad, Mr. Lincoln Bush, chief engineer, and was built and erected by the American Bridge Co.

OIL ENGINES up to 85-h.p. in capacity have been supplied by the Green Engineering Co., of Bath, Eng., for river boats. They are stated in "Engineering" to run equally well with petrol of 0.704 specific gravity or crude Texan oil of 0.94 specific gravity.

The Testing Engineer.

Presidential address of Dr. C. B. Dudley before the American Society for Testing Materials.

The gradual widening of the scope of the word "Engineer," is very interesting. Used apparently as long ago as the time of William the Conqueror, to designate one who had the ability to design and construct works of value, such as castles, or fortifications, or bridges, especially in connection with military affairs, it soon took on a wider meaning, and was properly applied to men having ability to design and construct works of practical utility in times of peace. The military men having simply been called "engineers," it became desirable to designate those who were doing similar work in times of peace, in some way to distinguish them and accordingly in contradistinction from the military engineers, they were called "civil engineers," a designation which remains up to the present, and characterizes some of the ablest men of the time. It would hardly be possible, or perhaps worth our while, to attempt to follow up historically the successive developments of this word "engineer." Suffice it to say that as time progressed, those who were able to design and construct something of value in the realm of mechanics, or other fields of human effort, were called "Mechanical Engineers," "Mining Engineers," "Naval Engineers," "Electrical Engineers," or indeed "Chemical Engineers." It is worth while to notice also that, as time has progressed, the meaning of the word, as well as its application, has broadened. Primarily applied apparently to one who had genius born in him, and therefore who had within himself the power to originate and to execute in course of time, we find the term applied to those also who simply direct, or carry to successful conclusion something they may have taken in hand. Indeed at the present time, the one who controls the machinery of a ship, as well as the one who handles the throttle of a locomotive is called an "engineer." And finally it is apparently no abuse of words to say of a man who has guided any scheme in which he was interested, with ingenuity and tact, or overcome obstacles by contrivances and effort, that he has successfully engineered his project through. In view of these thoughts, we are perhaps justified in regarding the man engaged in testing as an engineer, and not only in choosing "The Testing Engineer," for our title, but also, in discussing in some of his relations, that man who, if we read the signs of the times rightly, is becoming every day more and more prominent in the industrial world, and as time progresses, is destined to play continually a more and more important part in the development of our civilization.

The field which the testing engineer occupies, and the cause to which his loyalty is due, may perhaps wisely claim a few moments attention. It is plain that the testing engineer acts in a threefold capacity. He is either an investigator, or a counsellor, or a judge. He is finding out new truths, he is protecting the interests of his client, the producer, or he is determining by his tests, that contracts are being fulfilled, or specifications lived up to, in the interests of his client, the consumer. While all three forms of the testing engineer may be and often are engaged in research, in investigating a knotty problem, or devising means of demonstrating a point, it is perhaps more commonly the work of what may be called the "unattached testing engineer," to make investigations. The professors in colleges, especially those having a genius for experiment, and indeed independent investigators, who as the result of business shrewdness or by good fortune, are so situated that they are not compelled to struggle for an existence, are continually adding to the sum of human knowledge, by their tests and experiments while laboring in this field. They have no clients to satisfy, no employer's interests to defend, and no antagonism to overcome, except, perchance, the unwillingness of nature to yield up her secrets. Their loyalty is to the truth alone; their stimulus, their zeal for knowledge, and their reward, the approbation of their fellows. These seem to be almost ideal conditions for securing the truth, and it would seem as though results obtained by such experimenters, or testing engineers, and under such conditions, ought to be accepted and acted on without question. But we venture to suggest that there is one desirable, not to say essential element, in the search for truth, that is lacking in the conditions outlined above. This is the element of human antagonism. Perhaps an example will best make the point clear. The subject for investigation, we will say, is a method for determining phosphorus in steel. The professor or independent investigator, makes his studies and experiments, and publishes his results. During the whole investigation he has been actuated by no desires, except to get at the truth. There has been no temptation except perhaps the desire to finish the investigation, to stimulate him to neglect any essential point, to give any results or draw any conclusions that the most rigid interpretation of the facts could not warrant, and hence, so far as accuracy is concerned, it would appear as though no question should be raised. And yet so great is our belief in the value of human antagonism, where the truth is involved, that we cannot help saying that we would prefer a method which resulted from the contentions of two chemists, the one of whom was the employee of a consumer and who was trying to make out that the sample on which they were both working contained more phosphorus than the specifications allowed; and the other of whom was the employee of the producer, and who was trying to show that the phosphorus in the sample was below the requirements of the specifications, there being a large commercial transaction involved in the result. We cannot help feeling that every point in the method would receive much more severe criticism, and consequently if it survived, would be much more worthy of confidence under these conditions, than if it was brought out by a single experimenter making investigations for the sake of publishing them. So greatly does the legal fraternity rely on the element of human antagonism as an essential feature in the development of truth that we are entirely safe in saying that the whole structure of legal procedure is based on this foundation. It may not be amiss here, also, to quote from one of our instructors in chemistry, who had reached the philosophic age, and who in a very dry way used to say that during his active work, he had tested many published methods in analytical chemistry, which for some reason not necessary to explain, always apparently gave better results in the hands of those who devised them than he was ever able to get from them. We fancy it hardly needs saying that in this matter there is no intention of questioning the integrity or reliability of investigators who are studying the truth for the truth's own sake. The point we had in mind was to suggest the thought that perhaps those who are accustomed to glorify pure science, may have overlooked one fairly important element in the development of truth.

Returning to the testing engineer: As already indicated, the field of work of this important element in the industrial world seems to be either to find out new things, or to protect the interests of the producer or consumer. And there are three kinds of testing engineers to occupy these two fields, viz.: The unattached engineer, the consumer's engineer and the producer's engineer. At first there were apparently only two kinds of testing engineers, viz.: The unattached and the consumer's. But it did not take long after consumers began to study and test materials and prepare specifications, before the producers found it necessary to protect their interests and defend their materials by means of testing engineers in their own employ.

It is perhaps hardly necessary to say that in this, our analysis of the scope and field of the testing engineer, we have not forgotten the various inspection bureaus, and testing laboratories, which are doing such excellent work in various parts of the country. As we understand the matter, these organizations while perhaps not strictly covered by the definitions given, in that they do not derive their continuous sustenance in such a way as the unattached testing engineers, nor in the same way as those who defend the interests of the consumer or the producer, and in that way they have an independent organization, and owe loyalty only where it is paid for; yet in a certain sense these independent organizations do perform exactly the same functions as the three classes of testing engineers which we have described. Any one of them will make investigations either in the interests of a client or for the sake of the truth alone; any of them will temporarily, or continuously if the retainer be sufficient, defend and care for the interests of a consumer, or will render a like service for a producer, provided, of course, that the interests of the two are not antagonistic at the same time. So that we cannot help feeling that the three kinds of testing engineers mentioned, the unattached, the producer's and the consumer's, fairly well cover the field.

What now shall be the cast of mind, and what the mental equipment of the testing engineer? Upon the first of these topics it is difficult to say much that is positive. It is perhaps easier to say what kind of mind will not succeed in this branch of engineering than to say what the positive requirements of a successful testing engineer are. We will perhaps all agree that he should be independent, self-reliant, gifted with the power of analysis of facts, as well as with the power of drawing conclusions from the data at hand. He should be ingenious in devising methods to demonstrate the points at issue, and a careful observer of data. He must keep himself free from bias or prejudice and take especial pains that he does not deceive himself. He should be fond of experiment and have a genius for it. Many times during our nearly thirty years' attempt to do something in the line of the work of a testing engineer we have had occasion to paraphrase the Latin apothegm and say, "Experimenters are born, not made." He should keep constantly in mind the end to which his experiments tend, and understand clearly the effect of every step in the progress of his tests and its influence on the final result. Above all, he should be a thinker. No man who, when a problem is presented to him, simply searches his memory for whatever he may have learned in the schools, or have perchance picked up in his reading, which bears on his problem, has any especial call to be a testing engineer. We are quite ready to allow that the power of seeing analogies between your own problem and one that some one else has had, and perchance successfully solved, is a legitimate and useful, not to say time-saving, habit of mind; but the point we want to make is that the one who habitually and continuously approaches every problem through memory or by studying up what others have done, is far less likely to succeed as a testing engineer than one who habitually attacks a problem by an analysis of its elements.

But it may be urged, if experimenters are born, not made, and if so much depends on cast and habit of mind, what can the schools do in the way of training and furnishing mental equipment to produce successful testing engineers? We answer, much, every way. While it is probably not possible for any school to make a thinker out of a dreamer, or a successful experimenter out of a numskull, we still claim that, given ordinarily fair mental endowment, it is possible for the schools to make successful testing engineers, or to spoil the material they start with.

It hardly comes within the sphere of this paper or coincides with our present purpose to say anything about the curriculum of studies best calculated to fit a man to be a successful testing engineer. This is neither the time nor the place for such a paper, although we may possibly say something a little later about the self-education of the one who expects to spend his energy in this field of work. At this place we will, however, touch upon one or two points in connection with methods of teaching. Our observation of what the world wants today, not only in the field and work of testing engineers, but also in almost every other field, is men who can think, men with minds so trained and so fitted with mental equipment that when unexpectedly and for the first time put in presence of a combination of circumstances where action is necessary they will know what to do and how to do it. This may look like a very severe dictum to apply to recent graduates, with their limited experience and small accumulation of facts, and yet we cannot help feeling that in some degree this dictum may legitimately be applied even to them, and that if they have been properly trained by the schools they will show in some measure a capacity for meeting unexpected and unforeseen emergencies. But it may be asked, What teaching and what training leads to the development of this capacity? We answer that while it is undoubtedly true that the mental characteristics of the student himself are a most important factor and that it is clearly impossible to make a thinker of every student in the class, yet, as we understand the matter, that teaching which brings out and keeps prominent before the mind of the student the principles underlying the theme which is under consideration, be the subject of study whatever it may, rather than that teaching which fills the mind of the student with methods, with manipulation, and with accumulated information, embracing a taste of many subjects, will have a tendency to develop the kind of mind we are looking for. A somewhat extensive acquaintance with recent graduates from the chemical schools for a number of years past has led us to fear that methods, manipulation and accumulated information were given undue prominence and that principles and reasons why were not sufficiently insisted upon. We are clearly of the opinion that the schools truly desire to furnish what is wanted and that the situation as we seem to find it is due to the effort on the part of the schools to turn out their graduates fitted to at once begin to earn a livelihood, or perchance to take charge of independent work. We are compelled to say that while the motive seems praiseworthy, and a legitimate yielding to the demands of the times, we cannot help feeling that many a graduate will, under such tutelage, fail to reach the success which, with a different method, would have been legitimately in his grasp.

Perhaps an illustration will make clear the difference in methods of teaching which we have in mind. Not long ago we separately asked three recent graduates, each one from a different, entirely reputable school, why nitric acid is used to dissolve steel when one is going to determine the phosphorus. Why not use some other acid just as well? Two of the three replied that they supposed that nitric acid was a good solvent for steel and they knew of no reason why any other acid that would dissolve the steel would not do as well. The third answered that in order to take the next step in the process it was essential that the phosphorus should exist as ortho-phosphoric acid, and that nitric acid, being an oxidizing agent, would bring the phosphorus to that condition. Now, each of these three recent graduates knows how to determine phosphorus in steel, and, as a matter of fact, each of them had done it in an entirely acceptable manner and under check for six months or more in my own laboratory. All three of them were familiar with the method and with the manipulation. But, as we look at it, only one of them had been properly taught. He not only knew the method and the manipulation, but he also knew the reasons why and the principles underlying the method. One of my assistants put the matter very forcibly. He said: "The chemist who knows methods and manipulation gets along swimmingly as long as everything goes well, and perhaps turns out more work in a day than a thinking chemist who understands the reason why for every step in his analysis; but let a difficulty arise and your method chemist is absolutely lost."

There is another phase of this case which is perhaps worthy of a moment's notice. Given two young men of equal ability, and let both of them go through good technical schools, both graduating, say, as chemists, or as mining, mechanical, civil or electrical engineers. The one during his course of study has covered much ground, has stored his mind with facts, has learned carefully and well the methods and manipulation required in the branch chosen. The other has not covered so much ground, but every bit of information that he has he thoroughly understands; he has acquired principles rather than a large array of facts, and he knows the reason why. Let, now, these two begin work after graduation in the same place, and we are ready to confess that the former will make the best showing and progress the more rapidly for the first year or two, but, if our observation is worth anything, the latter will distance his competitor at the end of ten years.

But we are perhaps spending too much time over this point. The mental equipment which the schools furnish is only a fraction of that needed by the testing engineer, especially if he happens to have it as his field of work to defend the interests of a great consumer. It is legitimate and reasonably to be expected that the schools should teach a young man how to learn and should start him in a number of subjects, but his real education comes later. We often say to our young men that the two things that a recent graduate needs most are experience and acquaintance. Under the head of experience we comprehend the arranging of the information already acquired so that each part will have its due, and only its due, prominence; the accumulation of additional information, either by reading, by close and continuous study of his main theme or related branches—we fancy it almost goes without saying that the man who expects to reach even moderate success as a testing engineer must study harder the first five or ten years after graduation than he did at any time while in school—we say a man must accumulate experience by arranging the information already acquired by reading, by study and actual contact with industrial processes and with the world's work, in every possible detail, and above all a man must acquire experience by actual wrestling with problems that may be committed to his care. It is apparently not essential in order to gain experience that one should successfully solve his problems. Faraday was accustomed to say that he actually learned more by his failures than from his successes. We cannot, we think, too emphatically insist on the importance to the testing engineer of self-education, of the broadening of his field of knowledge and of the acquisition of facts. The testing engineer should be an omniverous student. Nothing too trivial to interest him, nothing too remote from his present line of work to make a legitimate demand on his attention, should opportunity offer. The schools, if they have done their duty, have given you a more or less trained mind and have taught you how to learn. It is your own fault if you do not broaden every day. You can never tell what moment you will need, and badly need, some out-of-the-way fact. Store them up against that time of need.

Perhaps you will forgive me an illustration or two on this point. We recently saw a broken steel car axle. The break occurred ten or twelve inches from the end of the axle. On examining both ends there was some appearance of seams, not radial, but rather, in a sense, irregularly parallel to the circumference. These seams suggested that probably the axle was made from a billet coming somewhere near the top of the ingot and that the seams were in some way connected with the pipe. It was reasoned that if this were true an analysis of the metal from the surface and from the center of the cross-section of the axle would show segregation, and that if, for example, much higher phosphorus were found in the center than at the circumference, it would almost be a demonstration of the location of the billet. Of course, the whole object of the study was to see if any information could be obtained that would prevent the acceptance of such bad axles in the future. It should be mentioned that the broken off piece was sawed in two lengthwise, and that when this was done from one of the halves a core amounting to about a third of the cross-sectional area actually fell out, showing that the seam indications at the end were genuine and that the seam did actually exist. The analysis above referred to was made, and, to our astonishment, showed lower phosphorus in the center than in the circumference. This seemed to settle the question as to the relation between the seam and the pipe, and, indeed, we regarded it as conclusive evidence that the billet from which this axle was made was not taken from too high up in the ingot, but it left unsettled the cause of the seam. Perhaps, however, a few words farther on certain well-known phenomena in steel metallurgy will help us in clearing up the point. It is obvious that if in a big ingot a portion of it contains more than the normal amount of phosphorus, carbon or sulphur, as is actually the fact in the case of segregation, it must follow that there will be parts of the ingot which will contain less than the normal amounts of these constituents. It is generally assumed that the outside of a forging, like an axle, gives very close to the normal analysis of the steel, since from the method of manufacture this outer metal was near the surface of the ingot when the metal was cast and consequently cooled too quickly to permit perceptible segregation. Also if we are right, the analysis of borings taken from different parts of the inner face of an ingot sawed in two lengthwise for the purpose shows that phosphorus, carbon and sulphur, near the middle of the lower third of the ingot, are usually below the normal. Now, since the phosphorus in the center of our axle was lower than in the circumference, it seems evident that the billet from which it was made must have been from somewhere in the lower third of the ingot. Apparently, therefore, we must look here for the cause of the seams. The steelmakers present have undoubtedly some time since foreseen the cause of the difficulty with this axle. For the benefit of the others we may say that seamy bottoms of ingots are now usually explained by wet or insufficiently dried bottoms of ingot molds. The steam or other volatile material generated by the heat of the molten metal can apparently only escape up through the molten metal itself, forming a seam, which the subsequent treatment does not weld up.

Another brief illustration will perhaps emphasize the importance to the testing engineer of familiarity with the minute details of industrial processes. A couple of years ago, while the finishing cut was being taken on a steel driving axle in a lathe, the operator noticed in the freshly cut surface what appeared to be a small flaw. On testing this with a pin the pin disappeared and quite a length of fine wire followed it. On taking out a transverse slice of the axle at this point a cavity was found in the metal which would hold half a pint or more. The walls of the cavity were perfectly clean and bright, and but for the fact that the finishing cut just happened to open up the cavity a trifle its presence would not have been suspected, and the axle would have gone into service. It is perhaps safe to say that one-quarter, or possibly one-third of the cross-sectional area of the axle was embraced in the cavity. We have seen a number of such cases, and, unfortunately, the phenomenon is not too rare. Almost any practical steelmaker, when asked for the cause of such a cavity in what is apparently a solid piece of metal, would probably laconically answer, "Careless heater." In order to understand this statement it is necessary to say that many driving axles, even when they are finished, are about eleven inches in diameter, and that the bloom from which they are forged is considerably larger. If, now, such a bloom when cold is put into a hot furnace, the outside layers get hot long before the inside has begun to raise much in temperature. A severe strain due to the greater expansion of the outside layers is accordingly set up, which strain is enough occasionally to actually rupture the inside. Subsequent forging opens out this rupture into a cavity. The rupture is usually accompanied by a noise like a pistol shot. The unfortunate part of the business is that, there being a number of blooms in the furnace at one time, it is impossible to tell which one has yielded to the strain. As would be expected, the larger the axle the more common this defect, and we know of one large railroad that bores a two-inch hole through every axle over eight inches in diameter that is destined for passenger service. The boring of the hole enables the cavity to be discovered, either by the behavior of the drill or by sight examinations after the hole is finished. It is interesting to know that something over 2 per cent. of all axles bored are defective in this way.

One or two points more and we have finished. It may seem an idle question, but it is certainly an interesting one, as to which of the three kinds of testing engineers has the most attractive field of work. The unattached testing engineer certainly has the greatest freedom, but at the same time the least stimulus. The producer's testing engineer undoubtedly has the best financial reward, but at the same time the narrower field. He has, however, the advantage of concentration, and as almost every modern industry has scores of unsolved problems connected with it, there is no reason, if he will work, why he should not achieve a great success. On the other hand, the consumer's testing engineer has unquestionably the broader field, the greater chance for initiative, and, perhaps more important than all, an opportunity to study the behavior of materials in actual service. This last item gives him a great advantage. The behavior in service is unquestionably the ultimate criterion by which every industrial product must be judged, and by whose decision, sooner or later, it must stand or fall. Undoubtedly, individual characteristics are a legitimate element in the choice, but our counsel would be to every ambitious testing engineer to get as near to the service as possible, and to this end to make some sacrifice, if necessary, to secure a position with a consumer.

And this brings us to another point. We have many times heard complaints of the dullness and unsatisfactoriness of spending one's days and weeks in making routine tests. We are compelled to say that we do not understand this. It is one of our sincere regrets that we are no longer able to do routine work. To us there is genuine pleasure in seeing how the test comes out in each individual case, although we may have performed the same operation over and over again. Moreover, there is scarcely a method in use today, either in chemical or physical testing, that is not capable of improvement, either in accuracy or speed, or both, and what better opportunity for suggestions could be desired than is furnished while the hands are busy doing that which from long practice they do almost automatically, and, with the attention necessarily directed to the subject in hand, leaving the mind almost free to dwell on possible changes leading to progress. Some of our very best thoughts have come to us while engaged in routine work. One is very near to Nature's heart when making tests, even routine tests, and if his mind at such times is alert and receptive, she will not infrequently give him a hint or disclose a fraction of some of her secrets to his view.

There is one more phase of the work of the testing engineer which will perhaps bear a few words, and that is the relation between the testing engineer and those whose material he is testing. This is unquestionably a delicate subject, one that we would all gladly feel did not need discussion or comment, and yet one that is constantly thrusting itself into prominence in some form. For the honor of human nature, it is gratifying to be able to put on record that during nearly thirty years of almost constant testing only once have direct financial considerations been urged upon us to influence our verdict in regard to material. On the other hand, we have heard representatives of entirely reputable business organizations say openly: "It costs us something to sell our goods, and it is entirely immaterial to us whether this money goes to our selling agents or to the representatives of the consumer." And this is not the worst phase of the matter. It is well known that the representatives of consumers who act in some sense in the capacity of testing engineers, in that their opinion or decision determines the placing of orders, not only accept substantial considerations from producers, but even demand them—if not openly, at least indirectly. The subject is one on which much might be said. An hour could readily be filled in narrating incidents and portraying the forms in which the hydra-headed monster, graft, manifests itself. We are confident that neither side is free from blame; we are equally confident that strict, open honesty is the only safe course. It may not be amiss to add that so insidious are the forms in which this evil manifests itself that, in the words of the Scriptures, they would at times deceive the very elect, and while it is not possible to discuss these matters without raising interminable questions of casuistry and metaphysics, it is possible to so act as to have the continuous approval of a good, clean conscience. No universal rule can be given. Each one, in a sense, must be a law unto himself. Perhaps the best every-day working rule for young testing engineers is, Do nothing you would not be willing to talk over with your employer, even in the presence of the other party. It is sometimes a bit hard to resist and say "No," but of one thing be sure: every departure from strict integrity will sooner or later return to plague you, and should your actions ultimately result in your downfall, from none will you get less sympathy than from those who may have contributed to your disaster.

The Oldest Brick Pavement in Buffalo is a small area laid with common brick in 1889 by private parties. The oldest work done by private contract is 2,067 sq. yd. of Syracuse brick laid in 1891 at a cost of $2.85 per square yard. Up to June 30, 1904, there were 203,073 sq. yd. of brick pavement in the city, which cost $466,338. The expense of the repairs of these pavements during the last fiscal year was $327, according to the annual report of Mr. C. M. Morse, deputy engineer commissioner.

New Mechanical Plant of the Connecticut Hospital for the Insane.

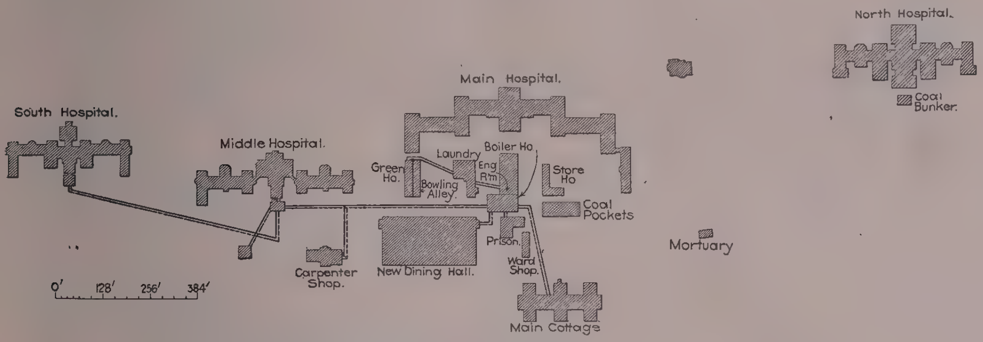
Important changes have recently been completed in the State Hospital for the Insane at Middletown, Conn., which now has four large hospital and dormitory buildings, several smaller cottages and numerous auxiliary buildings. At present it has over 2,200 inmates, while the number of doctors, supervisors, attendants and other employes is in the vicinity of 300. A 136x256 ft. dining hall has been installed in a central location, and the boiler plant, heating system, and other features of the mechanical plant, have been entirely remodeled and rebuilt. The structural details of the dining hall were described in The Engineering Record of November 5, 1904. The 100x250-ft. dining hall, on the second floor of the building, has a seating capacity of 1,600.

On the first floor are a large storeroom for supplies, cold storage for meat, butter and eggs, fruit, milk, etc., the bakery department, the kitchen proper, a large employes' dining room, and the sewing, sorting and ironing rooms for the laundry work. In the basement are the laundry and drying rooms, a large vegetable room, plunge, shower and tub baths. Elevated corridors connect the dining hall with the adjacent buildings and thus provide access from one building to another without exposure to the weather. There are about 1,100 ft. of this covered corridor, which is supported about 20 ft. above the ground.

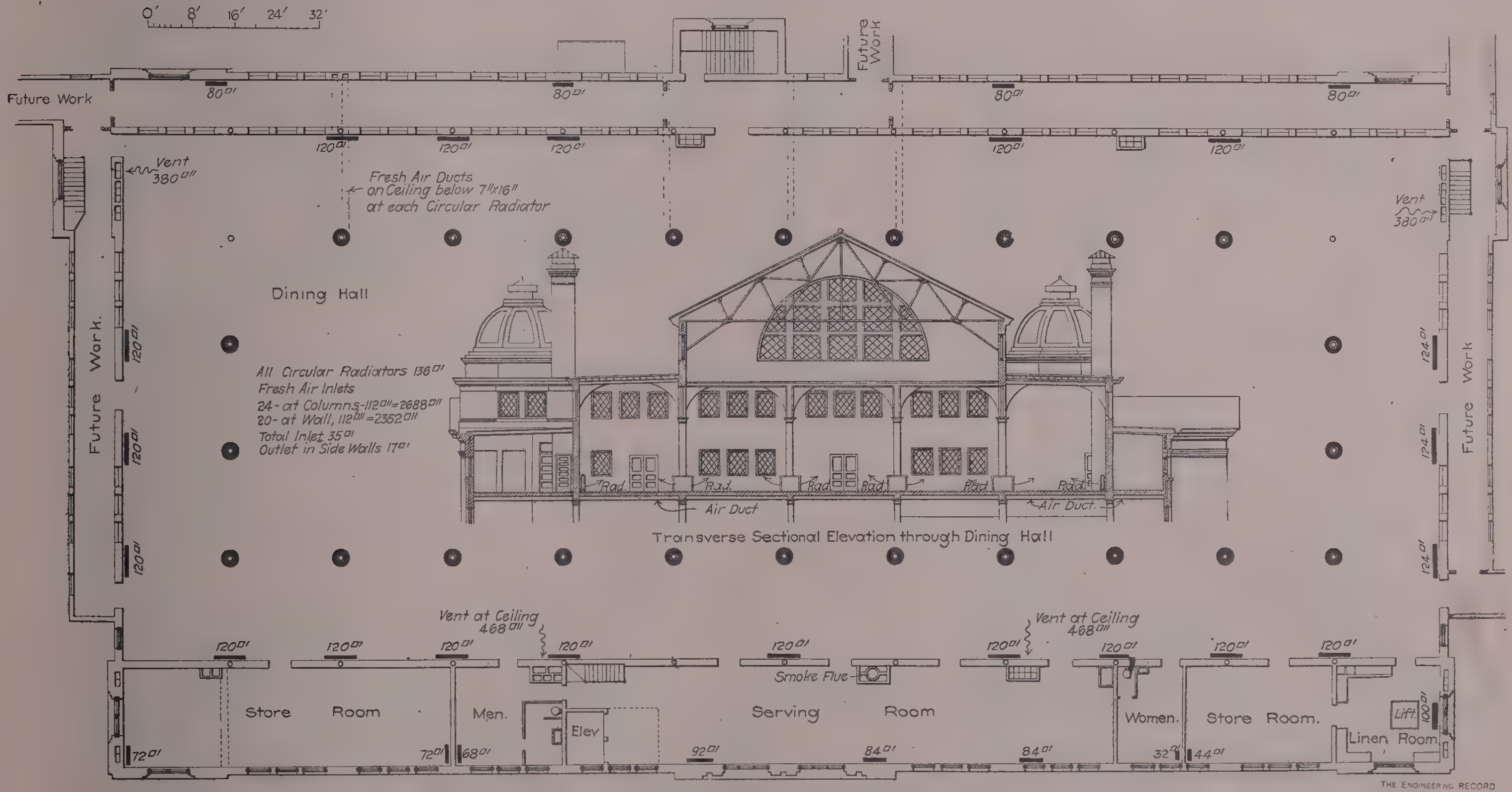
The new boiler house, near the northwest corner of the congregate dining hall, occupies the same position as the old boiler plant which was replaced, but covers nearly three times the ground space. It is 50 x 100 ft. inside the walls, and is sunk 15 ft. into the ground. An advantage of the depressed floor level is that the pipe and wire tunnels leading to the adjacent buildings enter the boiler room at the floor level. Eight boilers of the locomotive type are used, each of 100-h.p., and built by the Bigelow Boiler Co. They have simple settings and the waste furnace gases are led to the chimney through an underground smoke flue at the rear of the boilers. A Green fuel economizer of 26 sections has been installed. The chimney is an 84-inch brick stack, 150 ft. high, with a cap which weighs approximately four tons. A tunnel leads from the north end of the boiler house to a coal bunker, 100 ft. distant, which has a capacity of 1,500 tons.

The auxiliary equipment of the boiler room consists of two 7½ x 5 x 6-in. Warren duplex steam pumps for boiler feeding purposes, a 1,000-h.p. Cochrane open feed-water heater and oil separator, a feed-water filter, and the necessary traps, return tanks and pump governors for the return of condensation from the piping and heating systems to the boilers. The feed-water heater and the economizer have by-pass connections. The feed pumps deliver from the heater to the economizer through a 4-in. brass pipe line while the feed line distributing from the economizer to the boilers is a 3-in. brass line. There are also installed in the boiler room two Gleaner heaters, using exhaust steam to warm water for the main building, dining hall and laundry. A Locke damper regulator is in use for controlling the chimney draft pressure; this operates a large damper, 4-ft. 2-in. x 9-ft. 6-in. in size, in the main flue connection, which is hung so that all the weight comes on a ball-bearing pivot at the top, the pivot at the bottom being for the purpose of guiding only. In this way the ball-bearing is kept out of the flue and away from the destructive action of the flue gases. This damper turns so easily that only a 5-lb. window weight is required to open or close it.

The installation of the new boiler house on the site of the old plant and at a level 15 ft. below it presented interesting problems. Owing to the fact that the work had to be carried out in cold weather, it was absolutely necessary to keep the main plant in operation. There was but one spare boiler in the old plant and accordingly the work was begun by moving one boiler down to the lower level at a time and connecting it up temporarily, until all were lowered and the building could be completed and the new boilers installed. All this time there were over 800 people depending upon the old plant, so that there was no possibility of shutting down except between the hours of 10 p.m. and 4 a.m., but it is creditable to the contractors that the service was interrupted but once, and this was owing to the breakage of a valve flange on the cooking main, leading to the main building. Steam was shut off for less than one hour and a delay of only a few minutes was caused in the preparation of supper. This plant serves the main hospital building, the middle building, the south building, the dining hall, the main cottage, prison, greenhouses, carpenter shop, employes' cottage, and the old laundry building. At present the north building is not connected, but the boiler plant is of sufficient capacity to provide for this. There are 1,700 patients and over 300 officials directly dependent on the plant for heating, lighting, cooking and laundry service. An idea of the amount of steam required for cooking may be had from the fact that on days when corned beef is cooked by steam, it increases the coal consumption of the boiler plant by approximately two tons. The heating service of the institution embraces approximately 65,000 sq. ft. of radiation, both direct and indirect.



Location of Main Buildings of Connecticut Hospital for the Insane.



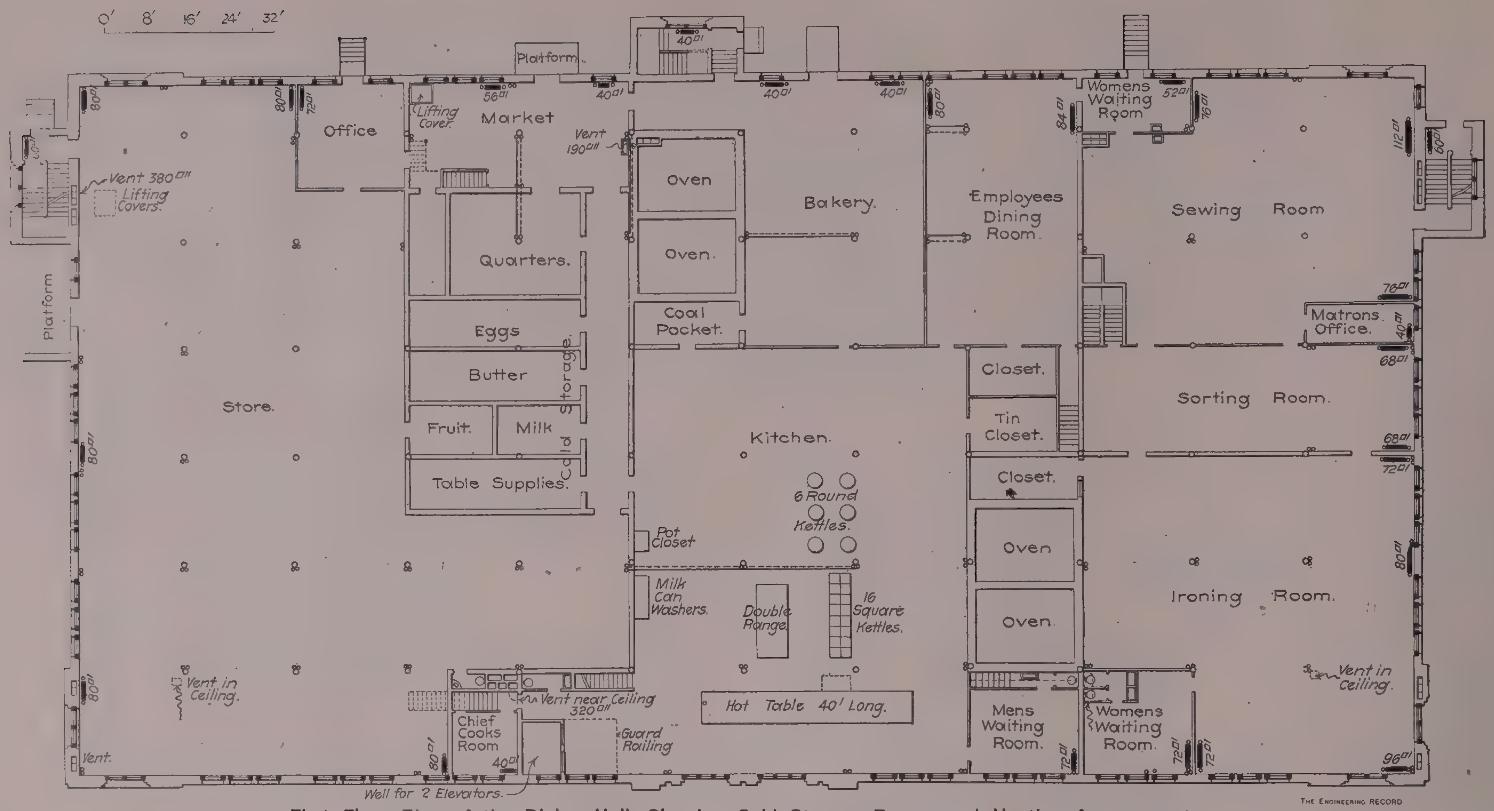
Main Floor Plan of the Congregate Dining Hall at the Connecticut Hospital for the Insane.

Every connection supplying steam for heat or power is so arranged that it can be fed in at least two ways independently. There are two steam headers, one of 15-in. extra heavy pipe, which supplies all the heating systems in the surrounding buildings and the other a 9-in. header of extra heavy pipe which supplies steam to the adjoining electric generating plant and to all the cooking and laundry apparatus. Each of these headers has a separate connection to each boiler, a 5-in. for the 14-in. main and a 4-in. for the 9-in. line, and the two headers are cross-connected for emergencies.

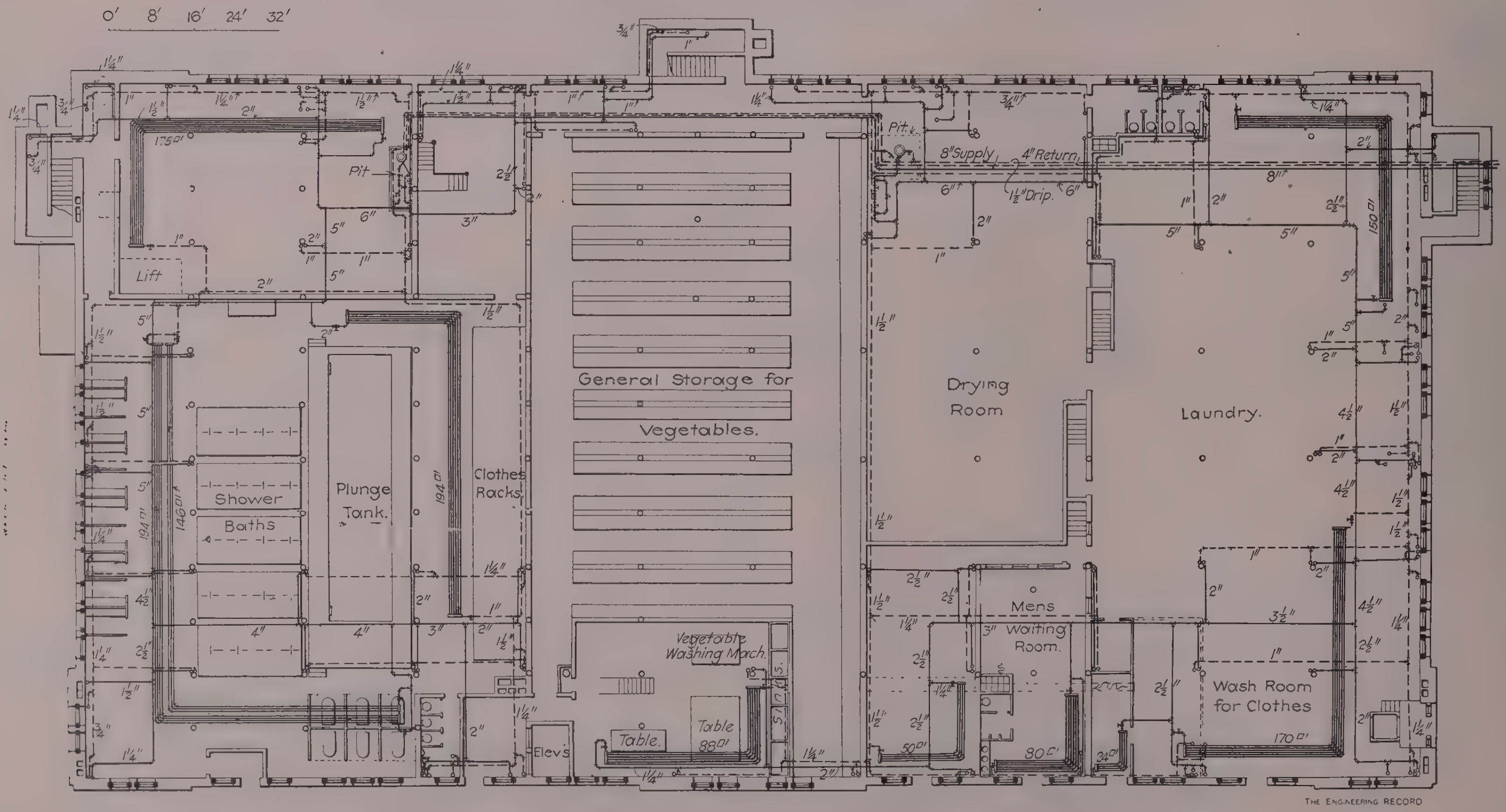
There are four systems of piping for steam distribution among the buildings, each carrying different pressures as follows: 90, 40, 30 and 1-5 lb. The high pressure system, carrying boiler pressure, 90-lb., supplies the engines of the electric generating plant, all boiler and refrigerating pumps, and indirectly the two lower-pressure lines through Waters reducing valves. The 40-lb. line, known as the cooking system, is used principally in the dining hall, although it is also carried to the main building and to the greenhouse, for auxiliary purposes. The 30-lb. line is carried to the main cottage, the middle building, the south building, the carpenter shop and to the employes' cottage; in these buildings the steam at 30-lb. pressure is first used in the hot-water heating, cooking and other apparatus, and then reduced to 4 or 5-lb. for use in the heating system. The low-pressure system (1-5-lb.) utilizes the exhaust from the generator engines and pumps for the heating of the dining hall building, and also to the main building when there is a surplus required by the former building. A complete reorganization of the heating system has been effected by the central boiler plant; where it was formerly necessary to carry 25 to 30 lb. in the local heating boilers in many buildings, it is now possible to do the work satisfactorily with 4 or 5 lb.

All condensation from drip pockets of the high-pressure system is carried back to the boiler house through a special system of drip piping where it is handled by an Albany steam trap which discharges into the Cochrane feed-water heater and receiving tank for use again in the boilers. All the other returns from the heating systems are also discharged into the feed-water heater. All high-pressure piping is covered with the sponge-felted asbestos pipe covering and all low-pressure with the fire-felt covering of the H. W. Johns-Manville Co., New York. The boilers are covered with fire-felt blocks, wired on and finished with cement, and the whole covered with heavy canvas and painted. The steam mains to all the buildings, except the dining hall, are encased in Portland sectional conduit, a system supplied by the same company, for the insulation and protection of underground steam and water mains. Some of the steam mains are 16-ft. below the surface of the ground, which was necessary to get a gravity return to the boiler house.

The lower floors of the dining hall are both heated by direct radiation throughout, while in the main dining hall a combination of the direct and the direct-indirect systems is used. All of the distribution piping for the heating system in this building is arranged on the ceiling in the basement. These pipes not being covered in most cases provide for the greater part of the heating in the basement, while in the larger rooms, such as the bath room, laundry, etc., there are ceiling radiators of long pipe sections suspended near the edges of the rooms. The first floor is heated by the risers leading upward from the basement to



First Floor Plan of the Dining Hall, Showing Cold Storage Rooms and Heating Arrangements.

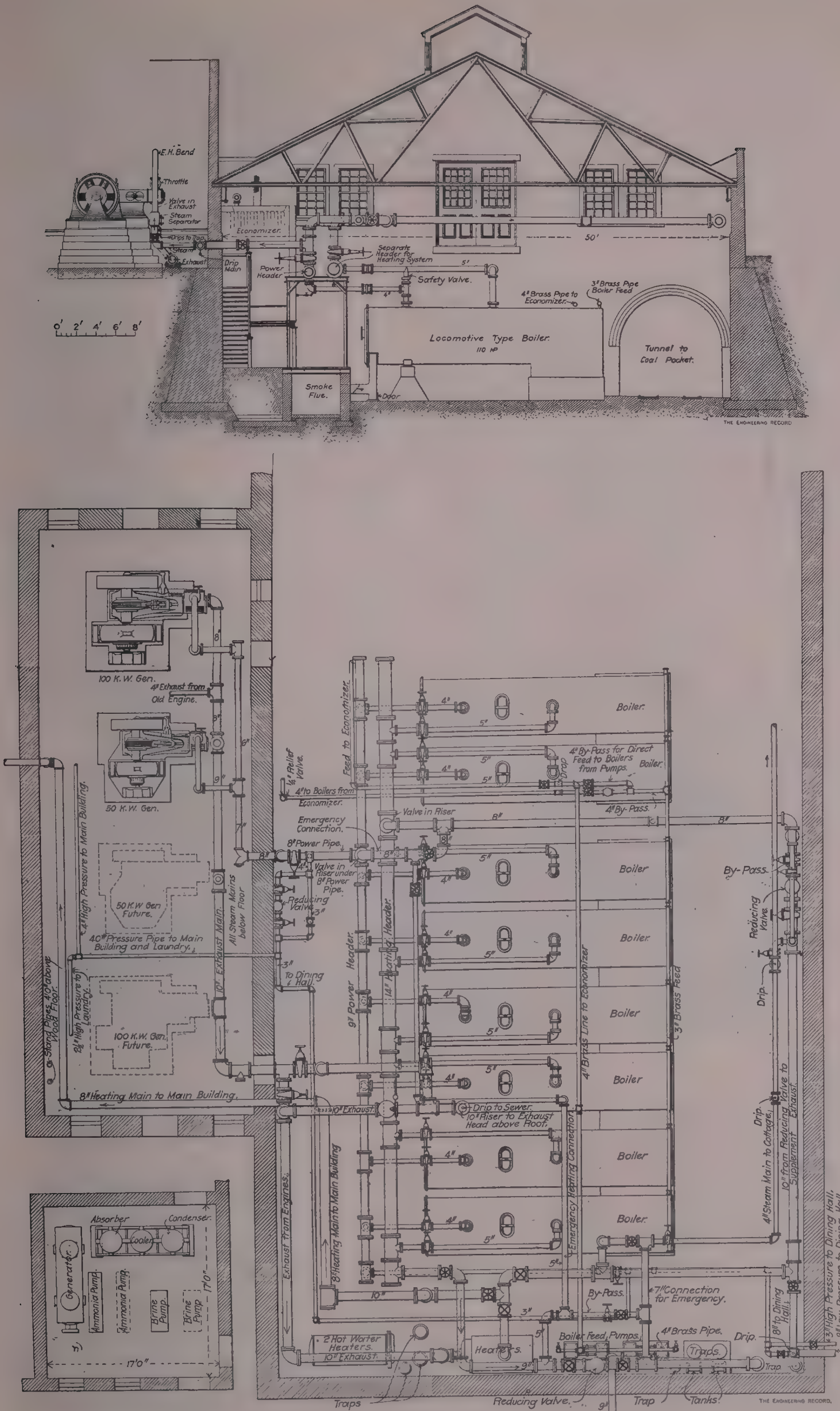


Basement Plan of the Dining Hall, Showing Steam Distribution Piping for Heating System.

supply the dining hall, and by radiators along the outer walls. In the main dining hall there are circular radiators around each of the columns and also radiators along the side walls. The circular radiators and a portion of the others on this floor have galvanized-iron duct connections to the outer air, for direct-indirect heating, as shown on the plan; both the steam supply to these radiators and the fresh air connections have Johnson thermostatic control. Each of the circular radiators, surrounding the columns, of which there are 24, has 136 sq. ft. of radiation, while each of the 20 sidewall radiators has 120 sq. ft., making in all 5,664 sq. ft. of radiator surface for the dining hall.

Vent flues have been built in the walls with openings into rooms where ventilation is necessary, and nine stacks of flues, embracing from two to ten openings, are carried up alongside the interior walls of the building. The main dining hall is ventilated by openings in the sidewalls, which aggregate 17 sq. ft. in area, and can be controlled from the floor. There is also a series of hot air reliefs in the ceiling of the room, which are thermostatically controlled, so as to give free heat relief and thus prevent overheating of the room. The fresh air inlets for this room, which lead in through radiators, consist of galvanized-iron ducts of 112 sq. in. cross-section; there are in all 44 of these ducts, which have a combined inlet area of approximately 35 sq. ft., all of which are controlled through air-operated dampers.

The cold storage department occupies a space upon the first floor approximately 30 by 60 ft. in area, divided into seven rooms of various sizes for each class of supplies, such as butter, eggs, milk, etc. The rooms are all 10 ft. high inside, giving thus a cubical volume to be cooled of approximately 18,000 cu. ft. To provide for this and the equipment for the manufacture of ice, a twelve-ton refrigerating plant of the absorption type has been installed by the Isbell-Porter Co., Newark, N. J. The plant operates on the absorption system, by the evaporation of dry ammonia gas under pressure, subsequently liquefying it,



Details of the New Power Plant for the Connecticut Hospital for the Insane.

expanding it for refrigeration and then absorbing the vapor into water for re-evaporation. The apparatus, consisting of a still or generator, a condenser, a cooler, an absorber, and the brine and ammonia pumps, is located in a small room adjacent to the engine room of the electrical generating plant, and the brine is carried to the cold storage rooms in the dining hall building through covered pipes in the basement. The steam for the evaporation process is supplied to the still from either the exhaust line or one of the low-pressure live-steam piping systems, as it is operated at a low pressure.

The cold storage rooms have wooden floors, outer walls, ceilings and partitions with sawdust fillings. The outside walls have 6-in. spaces for the filling and are finished on either side by a course of 1-in. No. 2 matched spruce lumber, a layer of laminoid paper and then a second course of spruce. The ceiling insulation of these rooms is of similar construction and also the partition walls, except that the latter have an interior filling space of 4-in. instead of 6-in. The flooring consists of a double course of similar spruce lumber with laminoid paper between, laid on 3-in. stringers to provide a 3-in. sawdust filling space above the concrete floor of the building. The brine cooling pipes are hung in banks of four and six either upon the sidewalls near the ceiling or suspended from the ceiling in the middle of the rooms; in either case they are supplied with troughs beneath them to drain off the atmospheric condensation.

It is interesting to note that the new mechanical plant has shown a marked saving over the old one, both in fuel consumed and labor required for its operation. This saving for the past year of operation amounted to approximately 10 per cent. of the amount invested in the plant, and it is expected that it will be increased the coming year. The plant was designed by the Richard D. Kimball Co., Boston, Mass., who also superintended its installation. The work was in direct charge of Mr. C. W. Kimball, of the above company, who acted as clerk of the work. The steam fitting was done by the day by Mr. L. D. Mills, who furnished the labor and material. Mr. W. D. Johnson, Hartford, Conn., was the architect for the new dining hall and other buildings.

The Need for Systematic Instruction in Highway Engineering.

A paper read before the Society for the Promotion of Engineering Education, by A. N. Johnson, Highway Engineer, Office of Public Roads, Dept. of Agriculture.

It is my purpose to bring before your association the need that exists for further and more systematic instruction in highway engineering than is at present given in any of the engineering schools in this country. This need exists for two reasons: First, because of the large sums of money which are now spent upon highway work which is not under skilled supervision; and second, because of the demand that already exists through the desire of the many communities to secure trained and experienced men for this skilled supervision.

There have been collected by the Office of Public Roads of the Department of Agriculture statistics showing the exact amounts spent on road work in over 1,000 counties. The actual sum as ascertained is $19,430,000. As these counties represent less than four-tenths of the country, there are annually spent today not less than $50,000,000 in maintaining the public roads and bridges.

A close study of the results obtained makes it a conservative estimate to say that at least one-half of this money is at present wasted, so far as beneficial results to the roads are concerned. It is a notorious fact that, with few exceptions, the roads in the various communities have improved but little, the results being wholly disproportionate to the large sums of money that have been raised for this purpose. In no other branch of constructive work is any such amount of money spent without skilled supervision. It is now recognized not alone by those who have studied carefully the situation, but by thinking people in general, that the results obtained are not what they should be and that there is something wrong in most communities with the present method of administering the road funds.

While this fact obtains such general recognition, the remedy is not so generally perceived, which is to have the road funds in the various communities administered by a man trained to his work, a highway engineer. The proof of this statement is readily demonstrated by the fact that in those communities where a decided advance has been made in highway construction and where good results are obtained it has been invariably under the management of engineers skilled in this class of work. These instances are all too few and are confined in the main to the few states where state commissions have organized state highway engineering bureaus.

The reason why there are so few men in the country whose training makes them capable of solving intelligently the problem or suggesting the remedy for this condition of things is the fact that little or no attention has been given to this subject in the engineering schools. It is the educated and trained men in the different communities who must always be depended on to take the lead and suggest in detail the remedy for whatever lack exists in the administration of public affairs.

It seems, therefore, if for no other reason than to point out the right path, that the technical schools of the country should provide the fundamental training necessary for a perception of the course to be pursued. These schools have had for many years courses of study in railroad problems and every civil engineer student in all of the larger technical schools has pursued systematic studies in railroad engineering, with the result that there have always been found men trained and capable of carrying on railroad development.

To be sure, the student's time in most of the engineering schools is already overcrowded with the various courses of study, and it would be impossible in most instances to add to the present requirements any large amount of work. But this does not seem necessary, for it would be quite feasible to offer the student the option of highway engineering or railroad engineering. Why is it necessary to give every student in civil engineering this practice in railroad engineering? There are great numbers of civil engineer graduates who never had an idea of taking up railroad work, nor any occasion to do so. On the other hand, there are great numbers of them called upon to build highways of various kinds and to perform a class of work for which they have had no systematic training. Why not, then, provide for such men a course in highway engineering and give to them the same fundamental principles in this branch of their profession that is given to railroad problems?

The average amount of time now devoted to railroad engineering in fifteen of the most prominent technical schools is 162 hours. For the most part this work is given in the first half of the third year and is divided into six hours a week of class-room exercises, and field work counting as the equivalent of three hours in the class-room, making a total of nine hours a week for a half year. Four out of these fifteen schools give no courses whatever in highway engineering, while the time devoted to such courses in the remainder amounts, on the average, to but 32 hours, which does not include any practice in the field, the courses offered consisting almost entirely of lecture and textbook work.

Instead of such a program, why not offer courses in highway engineering taking an equal amount of time to that devoted to railroad engineering? The field work in highway engineering should include the practical location of roads designed for various conditions, in which every student would have as good drill in the laying out of curves and the solution of various problems in surveying as now occurs in the field practice given in railroad work. The great difference between the field work in railroad engineering and in highway engineering is that in one instance the problem is solved from the standpoint of railroad economics and in the other from that of highway economics, and these require essentially different treatment.

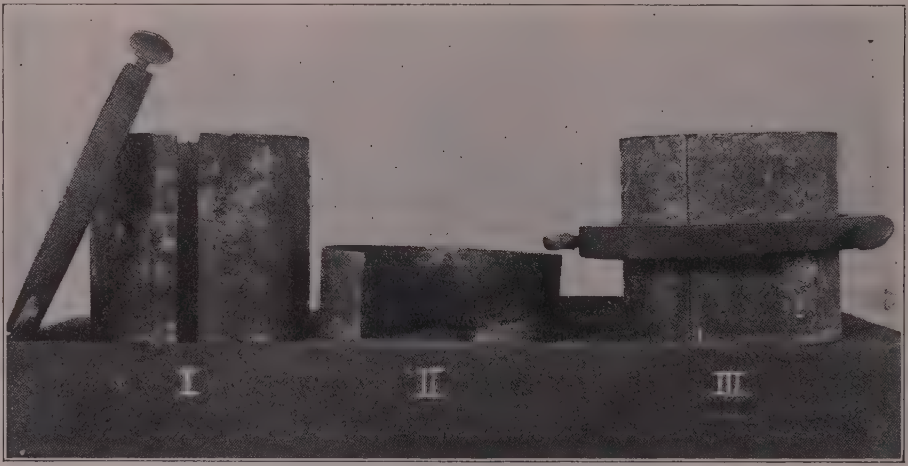
The class-room exercises could consist of the lecture work as at present given in many of the schools, supplemented by a much more extended study of the systematic treatment of various classes of roads, as city streets, streets for suburban development, parkways and boulevards, and rural highways, this combined with laboratory study of the various materials which enter into road construction, so as to give the student some well-grounded ideas concerning a rational, business-like treatment for a given condition.

Courses are now offered to the student in municipal engineering, for instance, outlining a systematic plan for a sewerage system of a city, and drill and training are given in designing a system considering the problem as one applying to a whole community. But none of the courses of study outline in a systematic way the problem of pavements for a city as a whole. The result of the lack of appreciation of such problem is to be seen in every city in the country. If fundamental training in this subject had been given in our large engineering schools, I do not think it possible that such haphazard methods as are now found could exist, even though the personnel of the various city engineering forces changes more frequently than is, perhaps, consistent with the best results.

To further illustrate the need that exists for men trained in highway work, the office of Public Roads of the Department of Agriculture, in order to secure men for its work, is giving a number of young engineer graduates a year's training in practical highway work, for which they are paid $50 a month. These engineer-students, as they are called, are given from two to three months' thorough drill in the laboratory, including practice in the preparation of plans and estimates and highway economics. They are then placed on actual highway construction where they must make a close study of the business methods and report on all of the various operations that come under their observation. After a year of this training they are assigned work where they are called upon to show not only technical skill, but also the executive ability necessary to make a proper demonstration of economical highway construction for a given locality.

Applications frequently come to our office for men to take responsible positions, and it is seldom a man can be suggested who is capable of entering upon the work. In many instances that have come under my own observation, communities desiring a trained highway engineer and willing to pay a good salary have been obliged to take men with little or no training in this line and suffer them to work along as best they could.

I believe that as soon as the lack of instruction in this great branch of engineering is perceived, the technical schools will provide courses that will be on the same high plane of efficiency as those which have long been given in railroad engineering. The highway engineer needs not only special training as to the building and repair of highways, but also all of the other courses that are usually given the civil engineer student. The problems of the highway engineer are in every way worthy of the best skill of the engineering profession. He has an opportunity to be of great usefulness and to feel that he is giving a service well worth his best endeavor, and one which will be an important means of adding to the progress and development of his community.



Mold for Cylindrical Test Pieces of Concrete in Compression.

A Mold for Forming Concrete Compression Test Pieces.

In the course of the initiation of an elaborate study of the effect of variation in the proportions and character of the materials entering into the composition of Portland cement concretes upon their strength, Messrs. Clifford Richardson and C. N. Forrest found that the purchase of a sufficient number of molds for the formation of cubes for the compression tests would involve a very large expense. One firm quoted $132 for twelve 6-in. cube molds with bottom plates; another quoted $7 each for the same mold. As these prices were practically prohibitive, recourse was made to the ingenuity of the laboratory machinist to supply the want and he designed a mold which they consider not only cheap but more satisfactory for cubes for several reasons. The mold was described by them at the recent meeting of the American Society for Testing Materials as follows:

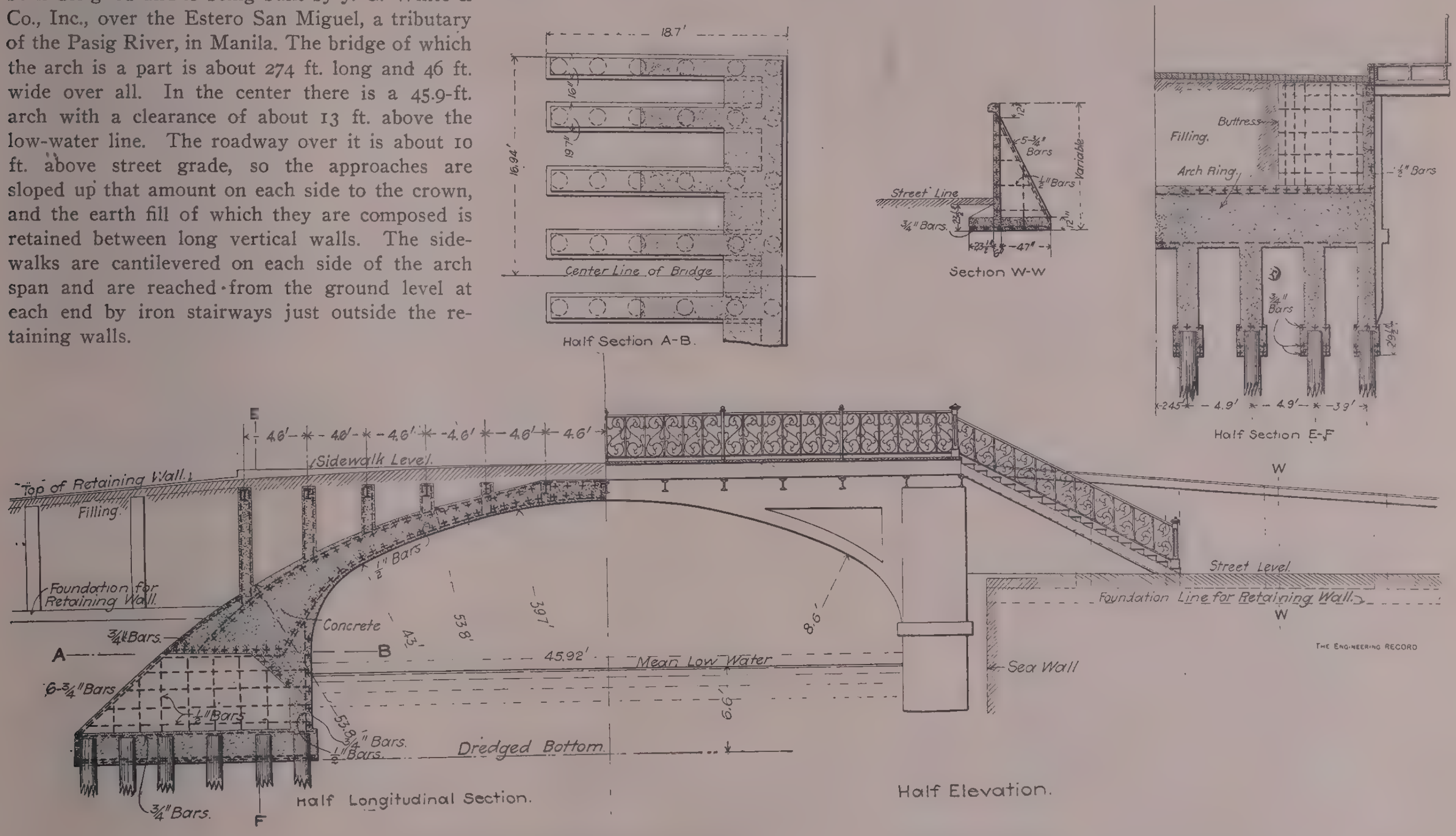
Tank steel ⅛-in. in thickness is cut in strips 6-in. wide and 18.85-in. long. It is then rolled into a circular form until the two endges are brought together within one-half inch. An iron ring is then cast 1-in. wide, ⅞-in. thick and 6⅝-in. in inside diameter. This is provided with two screws passing through it and of sufficient length, when the ring is slipped over the tank steel cylinder, to compress it at such points as to bring together and close the opening which exists owing to the spring in the steel, in this way forming a closed mold which is ready for use. In order that the collar may always be applied longitudinally and the pressure produced evenly a cylinder of slightly larger diameter is provided which shall hold the collar during compression parallel with the base. It has been suggested that two collars might serve more satisfactorily than one. The cost of such molds need not exceed $16 to $20 per dozen.

The advantage of the mold is that the test pieces can be much more uniformly compressed than in the case of cubes, where it is difficult to bring about thorough compression at the edges. That this is the case is shown by the fracture of the cylinders. There is no wedging out of the sides of the test pieces and the fracture is a perpendicular one in contradistinction to the hour glass form which generally appears with cubes.

Mr. W. Purves Taylor has made some comparisons of the strength of cylinders as compared to cubes, on the same mortar, which shows that a cylinder of neat cement at 28 days gave an ultimate strength per sq. in. of 5,026 lb. for the former and 4,920 lb. for the latter, or a ratio of 1.022 in favor of the cylinder. In the case of a test pieces made with a mortar consisting of 1 of cement to 3 of sand, the ratio was 1.133 in favor of the cylinder. On the addition of stone in various proportions the results obtained with the cylinder were not always as high as with the cube, but the average of all tests showed a ratio of 0.976 for the cylinder as compared with 1.0 for the cube. Mr. Taylor notes in many of these tests that the mortar was crumbly or soft. As the tests with neat cement and sand mortar without stone show a superiority in the strength of cylindrical test pieces the conclusion may be drawn that the cylindrical form is a satisfactory one. They also possess the great advantage that the test pieces can be used in a smaller machine than is required to break 6-in. cubes.

A Reinforced Concrete Bridge in Manila.

A highway arch of about 46-ft. span has just been designed and is being built by J. G. White & Co., Inc., over the Estero San Miguel, a tributary of the Pasig River, in Manila. The bridge of which the arch is a part is about 274 ft. long and 46 ft. wide over all. In the center there is a 45.9-ft. arch with a clearance of about 13 ft. above the low-water line. The roadway over it is about 10 ft. above street grade, so the approaches are sloped up that amount on each side to the crown, and the earth fill of which they are composed is retained between long vertical walls. The sidewalks are cantilevered on each side of the arch span and are reached from the ground level at each end by iron stairways just outside the retaining walls.



Highway Bridge with Reinforced Concrete Arch and Cantilever Sidewalks.

The arch and its abutments, independent of the retaining walls, make a structure about 80 ft. long, 34 ft. wide and 22 ft. high. In constructing it the channel was dredged to 10 ft. below low water, and on each side were driven eight longitudinal rows of six piles each, the tops of which were enclosed in the bases of the reinforced concrete vertical walls arranged, as shown in the plan, to form the transverse faces and longitudinal buttresses of the abutments. Just above water level these walls are united by a continuous horizontal slab of concrete which forms the skewback of the arch ring.

The intrados of the arch is a false semi-ellipse described from five centers, and the extrados is described with straight lines at the crown and skewback tangent to long-radius haunch curves drawn from two centers. This arrangement gives the ring a thickness of about 20 in. at the crown and 24 in. at the haunches. The arch is reinforced by horizontal bars parallel to the axis and about 15 in. apart, near the intrados and extrados, and by single layers of curved bars at right angles to the horizontal bars. Vertical spandrel walls, 10 in. thick and reinforced by ½-in. horizontal bars, 15 in. apart, are built in the faces of the arch ring, transverse to the bridge axis, and retain the roadway fill. They are stiffened by vertical webs or buttresses parallel to the bridge axis and about 4½ ft. apart. These buttresses, 12 in. thick, are rectangular in elevation and are integral with both the spandrel wall and the arch ring. They are reinforced by ½-in. vertical and horizontal bars, and serve as pedestals and anchorages for 10-in. horizontal cantilever I-beams, 11 ft. long, embedded in their upper parts and projecting 6 ft. through the spandrel walls to carry the wooden joists and planks of the sidewalks and the ornamental wrought-iron hand rails.

The retaining walls for the approaches are thin vertical concrete slabs reinforced by horizontal bars and stiffened by battered inside buttresses about 8 ft. apart. The footing is a continuous bed of concrete reinforced by longitudinal and transverse bars near the lower surface. The buttresses not only serve as piers for the sections of thin vertical wall slabs between them, but also stiffen the wide base.

The cost of the bridge was about $18,000, and it contains 550 yd. concrete, 8,325 lb. of I-beams and 37,500 lb. of ½-in. and ¾-in. reinforcement bars of star-shaped cross-section. The concrete was made with cement purchased from the Green Island Portland Cement Co., of Hong Kong.

The bridge was built under the direction of the City Engineer of Manila. The details were designed and the work executed by the Manila organization of J. G. White & Co., Inc., New York, whose general superintendent at Manila is Mr. H. A. Belden.

The Cost of Storm Sewers may be assessed equally on the entire area drained by the sewers, according to the Colorado Supreme Court in Denver v. Dumars, 80 Pac. Rep. 114. "Each tract ordinarily augments the aggregate volume of storm waters in a district in the proportion that its area bears to the entire area of the district," the court rules, "and the rule prescribed appears to approximate the extent of the benefits accruing to each lot by the construction of a storm sewer."

Impact Tests of Asphalt Paving Mixtures.

A paper read before the American Society for Testing Materials by Clifford Richardson and C. N. Forrest.

An impact test for determination of toughness of rocks has been designed by Mr. Logan Waller Page, of the Division of Tests, U. S. Department of Agriculture, and has been described by him in Bulletin No. 79, Bureau of Chemistry, as follows:

"This test is made on 25 mm x 25 mm (0.98 in.) rock cylinders with an impact machine especially designed for the purpose. Instead of a flat-end plunger resting on the test piece as in the cementation test, a plunger with the lower and bearing surface of spherical shape, having a radius of 1 cm (0.4-in.) is used. It can be seen that the blow as delivered through a spherical-end plunger approximates as nearly as practicable the blows of traffic. Besides this, it has the further advantage of not requiring great exactness in getting the two bearing surfaces of the test piece parallel, as the entire load is applied at one point on the upper surface. The test piece is adjusted so that the center of its upper surface is tangent to the spherical end of the plunger, and the plunger is pressed firmly upon the test piece by two spiral springs which surround the plunger guide rods. The test piece is held to the base of the machine by a device which prevents its rebounding when a blow is struck by the hammer. The hammer weighs 2 kg. and is raised by a sprocket chain and released automatically by a concentric electromagnet. The test consists of a 1 cm. fall of the hammer for the first blow, and an increased fall of 1 cm. for each succeeding blow until failure of the test piece occurs. The number of blows required to destroy the test is used to represent toughness. A sufficient number of results have not yet been obtained with this test to warrant their publication."

It seemed to the writers that a test of this description might be very satisfactorily applied to determining the toughness of asphalt surface mixtures, substituting for the rock cylinder one

TABLE 1.—IMPACT TESTS OF ASPHALT SURFACE MIXTURES, USING ASPHALT CEMENT OF 60 PENETRATION (BOWEN) 40 (DOW). TESTS MADE AT 40° F., 78° F. AND 100° F.

Analyses of the Asphalt Mixtures.

Asphalt used.	Test.	Bitumen.	Pass. 200	100	80	50	40	30	20	10
Trinidad	75,833	11.3	15.7	10	9	29	11	7	5	2
Trinidad	75,834	11.4	15.6	10	11	25	13	8	4	2
Bermudez	75,620	11.5	15.5	12	10	25	13	7	4	2
Bermudez	75,621	11.5	16.5	12	8	27	12	6	5	2
Maracaibo	75,691	11.8	15.2	10	11	26	11	8	5	2
Maracaibo	75,692	11.5	15.5	11	9	27	12	6	5	3
Residual Pitch,	75,810	11.1	14.9	10	11	23	16	7	5	2
Texas	75,811	11.0	16.0	10	9	26	12	9	5	2
Coal-tar Pitch	75,881	12.5	6.5	10	10	31	15	7	5	3

Tests Made at 40° F.

Asphalt cement.	Test.	Bitumen Per cent. in mixture.	Density of in mixture.	Number of blows.	Height of fall max. blow
Trinidad Lake	75,833	11.3	2.27	14	14 cm.
Bermudez	75,620	11.5	2.22	11	11 cm.
Maracaibo	75,691	11.8	2.15	14	14 cm.
Residual Pitch—Texas	75,810	11.1	2.28	11	11 cm.

Tests Made at 78° F.

Asphalt cement.	Test.	Bitumen Per cent. in mixture.	Density of in mixture.	Number of blows.	Height of fall max. blow
Trinidad Lake	75,833	11.3	2.27	29	29 cm.
Bermudez	75,620	11.5	2.23	17	17 cm.
Maracaibo	75,691	11.8	2.17	12	12 cm.
Residual Pitch—Texas	75,810	11.1	2.29	16	16 cm.

Tests Made at 100° F.

Asphalt cement.	Test.	Bitumen Per cent. in mixture.	Density of in mixture.	Number of blows.	Height of fall max. blow
Trinidad Lake	75,833	11.3	2.27	23	23 cm.
Bermudez	75,620	11.5	2.24	16	16 cm.
Maracaibo	75,691	11.8	2.21	10	10 cm.
Residual Pitch—Texas	75,810	11.1	2.29	7	7 cm.

TABLE 2.—IMPACT TESTS OF ASPHALT SURFACE MIXTURES, USING ASPHALT CEMENT OF 80 PENETRATION (BOWEN) OR 60 PENETRATION (DOW).

Tests Made at 40° F.

Asphalt cement.	Test.	Bitumen in mix. per cent.	Density of in mixture.	Number of blows.	Height of fall max. blow
Trinidad Lake	75,834	11.4	2.25	16	16 cm.
Bermudez	74,621	11.5	2.22	12	12 cm.
Maracaibo	75,692	11.5	2.20	17	17 cm.
Residual Pitch—Texas	75,811	11.0	2.28	16	16 cm.
Coal-tar Pitch	75,881	12.2	2.25	8	8 cm.

Tests Made at 78° F.

Asphalt cement.	Test.	Bitumen in mix. per cent.	Density of in mixture.	Number of blows.	Height of fall max. blow
Trinidad Lake	75,834	11.4	2.26	29	29 cm.
Bermudez	74,621	11.5	2.20	13	13 cm.
Maracaibo	75,692	11.5	2.19	12	12 cm.
Residual Pitch—Texas	75,811	11.0	2.27	14	14 cm.
Coal-tar Pitch	75,881	12.2	2.23	15	15 cm.

Tests Made at 100° F.

Asphalt cement.	Test.	Bitumen in mix. per cent.	Density of in mixture.	Number of blows.	Height of fall max. blow
Trinidad Lake	75,834	11.4	2.25	20	20 cm.
Bermudez	74,621	11.5	2.21	15	15 cm.
Maracaibo	75,692	11.5	2.24	10	10 cm.
Residual Pitch—Texas	75,811	11.0	2.29	7	7 cm.
Coal-tar Pitch	75,881	12.2	2.22	18	18 cm.

TABLE 3.—AVERAGE RESULTS OF IMPACT TESTS OF ASPHALT SURFACE MIXTURES FOR ALL TEMPERATURES, USING ASPHALT CEMENT OF 60 PENETRATION (BOWEN) OR 40 PENETRATION (DOW).

Asphalt cement.	Bitumen in mix. per cent.	Density of mixture.	Number of blows.	Height of fall max. blow.
Trinidad Lake	11.3	2.27	22	22 cm.
Bermudez	11.5	2.23	15	15 cm.
Maracaibo	11.8	2.18	12	12 cm.
Residual pitch—Texas	11.1	2.29	11	11 cm.

Average for all Temperatures Using Asphalt Cement of 80 Penetration (Bowen) or 60 Penetration (Dow).

Asphalt cement.	Bitumen in mix. per cent.	Density of mixture.	Number of blows.	Height of fall max. blow.
Trinidad	11.4	2.25	21	22 cm.
Bermudez	11.5	2.21	13	13 cm.
Maracaibo	11.5	2.21	13	13 cm.
Residual pitch—Texas	11.0	2.28	12	12 cm.
Coal-tar pitch	12.2	2.22	14	14 cm.

TABLE 4.—COMPARISON OF IMPACT TESTS OF OLD-TIME ASPHALT SURFACE MIXTURES, THOSE OF 1904 OF VARIOUS GRADINGS, AND PRESENT STANDARD MIXTURE.

Analyses of the Mixtures.

Test.	Year.	Bitumen. Per cent.	Pass. 200	100	80	50	40	30	20	10
70,354	N. Y. Standard. Mx. 1905.	11.2	17.8	12	10	27	12	5	3	2
30,035	1885	8.3	13.7	15	10	20	13	9	6	5
30,828	1895	8.7	11.3	10	12	34	17	4	2	1
30,831	1896	9.5	12.5	11	13	31	15	5	2	1
73,285	1904	10.9	11.1	16	17	33	6	2	1	3
73,394	1904	10.0	11.0	5	4	16	16	15	11	12
73,374	1904	10.9	14.1	7	7	28	16	10	5	2
73,456	1904	11.3	13.7	8	8	30	14	8	4	3
.....	1904	12.0	16.0	17	12	20	11	6	4	2

Impact Tests at 78° F.

Test.	Mixture.	Bitumen in mix. per cent.	Density of mix.	No. of blows.	Height of fall max. blow.	Sand used.
70,354	N. Y. 1905 Standard	11.2	2.25	29	29 cm.	
30,035	1885	8.3	2.23	6	6 cm.	
30,828	1895	8.7	2.24	7	7 cm.	
30,831	1896	9.5	2.23	15	15 cm.	
73,285	1904	10.9	2.25	28	28 cm.	Very fine.
73,394	1904	10.0	2.25	20	20 cm.	Very coarse.
73,374	1904	10.9	2.17	26	26 cm.	Deficient in fine.
73,456	1904	11.3	2.16	29	29 cm.	do.
.....	1904	12.0*	2.22	18	18 cm.	

*High residual pitch bitumen.

TABLE 5.—IMPACT TESTS AT 78° F. OF ASPHALT SURFACE MIXTURES AFTER IMMERSION IN WATER FOR 3 MONTHS USING ASPHALT CEMENT OF 65 PENETRATION (BOWEN) OR 45 PENETRATION (DOW).

Analyses of the Mixtures.

Asphalt.	Test.	Bitumen.	Pass. 200	100	80	50	40	30	20	10
Trinidad	69,645	10.5	16.5	11	12	23	13	7	4	3
Bermudez	70,354	11.2	17.8	12	10	27	12	5	3	2

Asphalt cement.	Test.	Bitumen in mix.	Den. of mix.	Number of Blows Orig. mat.	Number of Blows After immersion.	Hgt. of fall max. blow.	Lbs. per sq. yd. of water absorbed by cyl.
Trinidad Lake	69,645	10.5	2.22	21	20	20 cm.	.129
Bermudez	70,354	11.2	2.25	15	13	13 cm.	.157

made by the compression of the hot asphalt surface mixtures uniformly in a suitable mold. Quite extensive experiments have been conducted on a number of asphalt surface mixtures, which have varied as regards the grading of the mineral aggregate and the character and consistency of the asphalt cement. The results which will be presented here are of considerable interest.

The test pieces were made as follows: The surface mixture was brought to such a temperature as would be found necessary in handling it upon the streets, a weighed amount such as has been found by experience would yield a cylinder after compression of 1 in. in height is placed in a cylindrical mold, closely resembling the ordinary diamond mortar of the laboratory, of a diameter of 1¼ in. The mold is supported on a rigid block of timber 11¾ by 9½ in. square by 32½ in. high. The warm steel plunger is placed upon the top of the hot mixture above which is a cylinder of steel, weighing 10 lb., running in grooved guides, which can be allowed to fall upon it from a height of 3 ft. After a few gentle taps to seat the plunger the weight is raised and allowed to fall freely 10 times. The cylindrical mold is then inverted and the plunger introduced at the other end in a space left for this purpose by a boss on the base supporting the mold. Ten additional blows are then given on this end of the cylinder. In this way it has been found that a satisfactory and uniform compression is obtained. The cylinders are then weighed to determine if the density is satisfactory and measured to see that they are of uniform height, 1 in., or nearly so. On cooling they are ready to be tested, in the same manner employed by Mr. Page for rock cylinders, at whatever temperature may be selected.

Some of the results which have been obtained are represented in the accompanying tables and graphic diagrams.

Before discussing the results it is well to consider what the work done upon the test piece amounts to and what its destruction means. It has been suggested that the work required to produce fracture of the cylinder is the sum in kilogram-metres of all the blows rather than that of the maximum blow, but it has been found that while, in the case of a Trinidad mixture for instance, 29 blows are required when starting at a fall of 1 cm. and increasing 1 cm. at each subsequent blow, but two or three blows will produce the same result when applied immediately from a height of 29 cm. It is, therefore, a more accurate representation of the facts to express the results in the actual number of blows rather than by the sum of kilogram-metres for work done by all blows.

The work required to rupture such cylinders as have been tested, consisting of the same mineral aggregate and the same percentage of bitumen and of as nearly the same density as possible, indicates very conclusively the relative binding power of the different asphalt cements which were examined and the relative toughness of the mixtures prepared with them, under the different conditions of temperature at which they were tested. Tables 1, 2 and 3 give the data obtained for several well known asphalts, while Diagrams 1 and 2 express these results graphically.

A number of tests have also been made upon cylinders prepared from old pavements which have been exposed to traffic for many years on the street. Some typical results are presented in Table 4. It is evident that the earlier asphalt paving mixtures were not as tough or satisfactory as those prepared to-day and that this was largely due to a deficiency in bitumen, although it possibly may be attributed in some respect to differences in the grading of the mineral aggregate. In order to determine whether this was the case surface mixtures in which there was considerable difference in the character of the sand of which they were composed have been tested, the results appearing in Table 4, and these results show that if filler is present in sufficient amount a mineral aggregate deficient in fine material may form quite as tough a surface mixture as one that is much finer. Of course, a surface mixture in which the mineral aggregate is coarse would be much more readily attacked by water.

The effect of water action on asphalt surface mixtures has also been studied, cylinders having been tested after exposure in water for three months in comparison with others of the same composition preserved in air. The results of these tests are given in Table 5, from which it appears that one bitumen may suffer more in this respect than another.

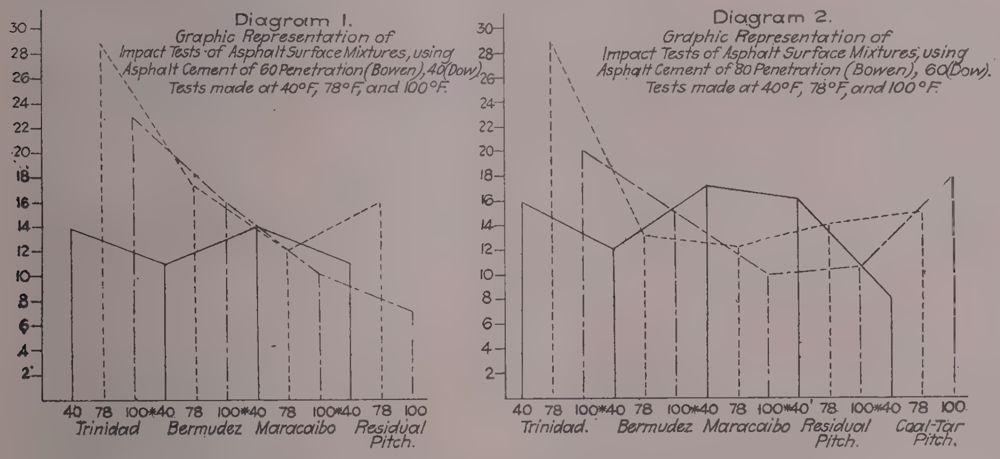
As a whole the results point to the probability that an impact test may prove of very considerable value in determining the merits of asphalt surfaces when used in connection with other reliable methods of examination.

Low-Pulling Portland Cements.

A paper read before the American Society for Testing Materials, by W. A. Aiken, general inspector of materials, New York Rapid Transit Railroad Commission.

The detailed strength requirements of the standard specification for cement adopted by this Society emphasized its recognition of the growing demand for a lower-strength, early-stage product than had generally in the past been specified. The revolution in the engineering profession's views on this subject is, in the author's opinion, largely due to the general knowledge that the Board of Rapid Transit Railroad Commissioners of the City of New York was requiring such cement, which, from the records of its Department of Inspection of Material, continually showed its greater value from long-time tests, the positive worth of such records being in the multitude of tests on a large amount of material.

The accompanying table shows the average strengths at various periods up to 3 years of several classes of cement, involving over 2,250,000 barrels inspected for the New York subway construction. The classification fully and clearly impresses the value of the specification cement by first showing test results on all accepted cement, these being arbitrarily divided into two classes, the first showing a neat strength less than 700 lb. at 7 days and the second showing a neat strength more than 700 lb. at 7 days. Next comes such cement as has been "turned over" to the manufacturer simply because the tensile strength was so high at 7 days as to render unlikely a satisfactory approximation to the specification gain requirement. Then follow the records of such material as was absolutely "rejected" at the 28-day period, solely for non-compliance with the gain requirement, which, for the benefit of those not conversant therewith, may stated to be 15 per cent in neat briquettes and 25 per cent. in 2:1 sand mixtures, between 7 and 28-day periods. Lastly, for comparison, strikingly illustrating the age value of low early strength material, are given similar period averages for accepted Natural cement used in certain parts of the work.



Diagrams of Impact Tests of Asphalt Surface Mixtures.

An examination of the results in the tables shows very satisfactorily that all the "accepted" cement, averaging as it does less than 700 lb. tensile strength neat at 7 days, as specifically called for by the Pennsylvania R. R. in that company's specifications for its New York-New Jersey tunnel work, predicated upon previous years' showings of the Rapid Transit Railroad tests as published yearly since the commencement of the work corroborates the wisdom of the original requirements, that low-pulling, early-stage cement showing a minimum gain of 15 per cent. in neat tests and 25 per cent. gain in sand tests at 28 days gives the best results thereafter.

The neat results of "all accepted" cement averaging at 7 days 689 lb. and at 28 days 799 lb. show a gain of 16 per cent. They continue to increase in strength at periods of 3 months, 6 months and 1 year, with a slight loss of less than 2 per cent. at 2 years and some further loss at 3 years. The sand mixtures of this same "all accepted" cement, averaging at 7 days 404 lb. and at 28 days 525 lb., show a gain of 30 per cent. These sand mixtures lose strength gradually after 3 months, as is customary with at least all such Portland lean sand mixtures, though not till the 3-year period is reached does the strength fall below that at 28 days and then very slightly.

Referring now to the subdivision of the "accepted" cement, that showing neat strength at 7 days less than 700 lb. actually 627 lb., and at 28 days 748 lb., giving a gain of 19 per cent., gives greater percentages of improved strength with age, and, while showing the same loss as the original set of averages at 2-year and 3-year periods, is at the latest date as strong as at 28 days. This cement's sand results, averaging at 7 days 362 lb. and at 28 days 515 lb., give a gain of 34.8 per cent. and hold up at the end of 3 years better than any accepted averages.

Referring now to the results of "accepted" cement pulling over 700 lb. neat at 7 days, actually 759 lb., and at 28 days 856 lb. and giving a gain of only 12.8 per cent., this shows a persistent falling away in strength at all periods; while its sand mixtures, averaging at 7 days 429 lb. and at 28 days 537 lb., though meeting the specifications, giving 25 per cent., show at 2 years and beyond a marked decrease in strength, both in comparison with its own previous periods as well as with similar periods of other classes heretofore investigated.

Examination next shows that the "turned over" cement actually showed a gain in neat samples of only 5.8 per cent. and in sand mixtures only 12.6 per cent., with marked retrograde results at all periods after 28 days in both neat and sand averages, the last periods contrasting badly. The "rejected" cement, comparatively a very small proportion of the total tested, since in this class is included only such material as was rejected simply on account of lack of gain, would indicate that the grading of material by its low tensile strength at 7 days, irrespective of any specified gain, would result (everything else being normal) in a better product, as shown from sand results which, after all, are the most important factors in determining a cement's value, than the high early stage strength cement so generally met with, since the tables show that the sand results of the "rejected" cement, while not as good as those of the "accepted" material, are much better than the "turned over" early high-strength cement.

LONG-TIME TEST OF NEAT PORTLAND CEMENT.

	24 hrs.	7 days.	28 days.	3 mos.	6 mos.	1 yr.	2 yr.	3 yr.
All "accepted" cement...............	300 lbs.	639 lbs.	799 lbs.	799 lbs.	799 lbs.	805 lbs.	791 lbs.	759 lbs.
"Accepted" cement pulling less than 700 lb. at 7 days................	392	627	748	779	781	793	780	750
"Accepted" cement pulling more than 700 lb. at 7 days................	309	759	856	841	822	835	606	774
"Turned over" cement pulling too high at 7 days	337	857	907	863	831	844	688	
Cement rejected for poor gain at 28 days	327	757	792	812	804	807	767	722
"Accepted" natural cement..........		220	320	404	475	497	477	

LONG-TIME TEST OF 1:2 PORTLAND CEMENT MORTARS.

	7 days.	28 days.	3 mos.	6 mos.	1 yr.	2 yr.	3 yr.
All "accepted" cement	404 lbs.	525 lbs.	568 lbs.	549 lbs.	552 lbs.	523 lbs.	492 lbs.
"Accepted" cement pulling less than 700 lb. at 7 days	382	515	582	566	542	519	506
"Accepted" cement pulling more than 700 lb. at 7 days	429	537	553	525	571	407	467
"Turned over" cement pulling too high at 7 days	460	518	474	409	384		
Cement rejected for poor gain at 28 days......	434	519	538	511	508	505	520
"Accepted" natural eement....................	215	331	495	601	639	682	

AVERAGE CHEMICAL ANALYSES.

	Silica.	Alumina.	Iron.	Lime.	Anhydrus Magnesia.	Sul. Acid.
All accepted cement	20.92	8.53	2.78	63.05	2.36	1.61
Accepted cement of less than 700 lb. at 7 days........	21.07	8.59	2.80	62.83	2.33	1.69
Accepted cement of more than 700 lb. at 7 days........	20.76	8.46	2.76	63.28	2.42	1.58
Turned over cement	20.05	8.10	2.80	64.18	2.45	1.55
Rejected cement	20.52	8.62	2.81	63.21	2.35	1.81

The ultimate value of low early stage cement is strikingly shown by the last line of averages, where the longest time results (though this sand mix is not of the same proportions as in the Portland cement) would indicate strongly the worth of early-stage, low-pulling cement.

Nothing in the work of the Department of Inspection has yet shown anything to warrant the slightest recession from the Commission's original position, where the ruling, first made from actual experience with some 100,000 barrels of accepted cement, corroborates the theory, and resulted in the formal promulgation of the specification requirements for a percentage of strength increase.

That this gain called for should be obtained normally, goes without saying, else any high-pulling cement properly "doctored" with excess of water might be made sufficiently low-pulling at an early stage to give a required percentage of gain; but, of course, such material could not figure as naturally low-strength cement, and, from the Department's records, would not hold up in strength.

To conclude, it is interesting to compare the average analyses of the different classes of Portland cement given in the tables.

THE ASSUAN DAM REPAIRS will require about 2 years for their completion, it is estimated. The work involves filling the deep holes scoured in the river bed below the sluices, and protecting the fissured rock on the downstream side by a masonry apron 180 feet wide and 6 feet thick.

Book Notes.

A sixth edition of the "Architects' Directory" has appeared. It gives a fairly complete list of the architects of the United States and Canada, classified by towns and States, and the architectural societies of which they are members. There is also a list of these societies with their officers and the schedule of minimum charges adopted by the American Institute of Architects. (New York, W. T. Comstock; cloth, 8vo, 116 pp., $2.)

The American Society for Testing Materials has issued in pamphlet form a valuable document for all users of cement. It gives a report by the society's committee on standard specifications for cement of the various stages by which united action toward uniformity in methods of testing and specifications has at last been brought about; the report of the committee of the American Society of Civil Engineers on methods of testing; notes by Mr. W. Hillebrand on the analysis of cements and the specifications for cement of the society, which are now the standard for this country. Copies of the pamphlet can be obtained from the secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia.

A short time ago the Civil Engineers' Club of Cleveland celebrated its silver anniversary, and marked the event by publishing, in very attractive form, a short historical sketch of the club's progress since 1880. The organization has been fortunate in carrying on its list of members not only a large number of enthusiastic young men but also many of more mature years who have attained the highest honors that can come to engineers. Among its presidents were Charles Paine, J. F. Holloway, W. R. Warner and Ambrose Swasey, who later became presidents of National engineering societies, and others of wide reputation. The book is particularly interesting at this time as indicative of the position to which a local engineering society can attain.

Tables for Roof Framing. By G. D. Inskip, New York, M. C. Clark; flexible leather, 12mo, 206 pp., $2.50.

This book represents a great amount of tedious work fully justified by the result. The first table gives the squares of numbers advancing by sixteenths of an inch from 0 to 60 ft. and the logarithms advancing by thirty-seconds. The second table gives the logarithms, advancing by thirty-seconds of an inch, of pitches per foot run from 1 to 18 in.. These logarithms are for hips and valleys having a 45 deg. plan, as well as for common rafters. The third table gives the natural sines and cosines and the logarithmic sines, tangents, cosines and cotangents for every minute of the quadrant. The fourth table gives the logarithms of numbers from 1 to 1,000 and the fifth table gives the logarithms of numbers from 0 to 1 in. advancing by sixty-fourths. The sixth table gives the decimal equivalents of fractions of a foot advancing by thirty-seconds of an inch, and of sixty-fourths. A brief explanation of the use of the table is given, and no draftsman who has had much work to do in laying out framing needs to be told that the book will be a great time-saver.

British Sewage Works. By M. N. Baker. New York, Engineering News Publishing Co.; cloth, 8vo, 150 pp.

A year ago Mr. M. N. Baker visited a number of British works for treating sewage, and this book contains a brief description of 27 of them, which he considers typical of the various systems employed. In an introductory chapter he explains the causes of the widespread attention paid to sewage disposal in Great Britain, and makes some general comments on them. The works are classified according to the final step in the method of treatment followed at each place. Under contact-bed works he describes those at Sutton, Exeter, Yeovil, Barrhead, Manchester, Oldham, Burnley, Rochdale, Hampton, Chadderton and Aldershot. Under percolating (continuous) filter works he places those at Birmingham, Salford, Accrington and Church, York and Salisbury. The sewage farms described are at Reading, Sandhurst, Aldershot Camp, Nottingham and Leicester. The chemical works are at London, Glasgow and Leeds. This classification is as good as any, probably, although most people have been accustomed to classify such works by their most important feature, speaking of the Exeter installation as a septic plant, for example. These works have been described in many publications before, but the notes in this book bring together in compact form a good description of their leading features, well arranged and bearing on every page the mark of the author's well-known critical carefulness. Moreover, each of the descriptions, with one exception, had the benefit of the criticism of the engineer of the works before it was published.

Letters to the Editor.

Oil Asphalts.

Sir:—Referring to the question of natural and oil asphalts discussed in your recent issues, it seems to me that there is a more important classification of asphalt than that of natural and distillate. While it is true that distillate asphalts are sufficiently unlike natural asphalts so that they can be readily distinguished at sight by any one familiar with them, nevertheless to a student of asphalt paving mixtures, for whom, presumably, Mr. Richardson's book is written, the classification of asphalts according to density is more important. This is almost a corollary of fundamental principles of physics. The property most characteristic of asphalt is viscosity and viscosity is a function of temperature and density. Asphalt in a pavement does its work satisfactorily within certain limits of temperature; at temperatures below freezing when the asphalt cement approaches in condition that of a solid body the asphalt cement fails, in a measure to do its work; at high temperatures, say from 100° to 140° Fahr., there is again a partial failure to do its work on account of approach of asphalt cement to a liquid condition with very little viscosity. It requires little practical observation to note that pavements deteriorate rapidly at extremes of temperatures and that wear is very little at medium temperatures.

The densest bitumens are insoluble in petroleum naphtha and a determination of the elements of an asphalt insoluble in naphtha is far more important to a true understanding of asphalt paving mixtures than any question of origin.

Mr. Richardson's formula is presumably as good as any—perhaps better—for paving mixtures in which the naphtha insoluble element is 20 or 30 per cent. In cases where naphtha insoluble elements considerably exceed this amount, and this class includes both natural and distillate asphalts, the formula requires modification. Increase in density increases viscosity and raises temperature at which the denser asphalt flows. An asphalt cement properly tempered having 20 per cent. of bitumen insoluble in naphtha might flow at, say, 105° Fahr., and an asphalt with 35 per cent. bitumen insoluble in naphtha might flow at 140° Fahr. To make a correct asphalt mixture under these conditions it is simply necessary to use less dust or fine sand than Richardson's formula requires. So far as my observations go it is disregard of varying densities of asphalt cements that is responsible for many errors in asphalt mixtures that have been attributed to inferior quality of asphalt.

Yours truly,

Newark, June 29. F. E. Puffer.

Local and National Engineering Societies.

Sir:—The presidential address of Mr. John W. Lieb, Jr., before the American Institute of Electrical Engineers, which you printed last week, and the various comments in your recent issues concerning local and branch technical societies, suggest that the field of such organizations is at last becoming divided up in the way that the late George S. Morison predicted in one of his scholarly addresses on the engineering profession. It seems to me, from personal knowledge of the work of several national societies in this and other countries in establishing local branches in large centers, that the latter do harm if they in any way interfere with influences tending to draw together men of all grades engaged in technical work of every description in any district. This general acquaintance with all specialists and all work of a technical nature in the vicinity is broadening in every respect, and does not scatter a man's interests over a large range of subjects, while keeping him well informed. This seemed to be the opinion at the recent meeting of the American Society of Civil Engineers at Cleveland, and, in fact, at all places where local societies for engineers are established.

Beyond and above these local organizations are the national organizations, and the subject of their relations is one that has attracted a great deal of attention. Unfortunately very few organizations have ever attempted to establish such a high requirement for admission to the rank of full member as the American Institute of Electrical Engineers, and if the other special organizations will follow its lead in this respect there must eventually result that hearty co-operation of national organizations which is so desirable and so very impracticable under existing conditions. Full membership in the organizations of the mechanical and electrical engineering societies is of an assured high character, but not in that of the mining engineers. Each of these organizations should determine by its action on applications for full membership whether the candidates are men of high standing in their specialties. If they are admitted to these organizations in the highest rank, then they are certainly suitable for the highest rank in the American Society of Civil Engineers. The latter is the oldest of the organizations, its members take the broadest views of engineering work by reason of the nature of their duties, and its constitution distinctly provides for admission to full membership of all engineering specialists, while the constitutions of other national engineering societies restrict membership to those engaged in the particular field of each organization.

It seems to me that if the broad-minded men in these organizations will once get together and discuss the matter of their relations without regard to the location of the societies' headquarters in one or several buildings, which is a mere trivial detail, it will be possible to organize the whole engineering profession in the country into a harmonious and influential body, and lift it out of its present condition of a group of mutually distrustful factions which are injuring each other in their endeavor to grasp additional honors for themselves.

Yours truly, M. Am. Soc. C. E.

New York, July 3.

CURRENT NEWS SUPPLEMENT

JULY 8, 1905.

DIRECTORY OF NATIONAL TECHNICAL SOCIETIES.

American Society of Civil Engineers. Secretary, Chas. Warren Hunt, 220 West 57th St., New York.

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York.

Association of Engineering Societies. Secretary, W. H. Merrill, Jr., Chicago.

American Institute of Mining Engineers. Secretary, R. W. Raymond, 99 John St., New York.

American Institute of Architects. Secretary, Glenn Brown, Washington, D. C.

Association of Engineering Societies. Secretary, Frederick Brooks, 31 Milk Street, Boston, Mass.

American Society of Heating and Ventilating Engineers. Secretary, W. M. Mackay, 235 Water St., New York.

Canadian Society of Civil Engineers. Secretary, Clement H. McLeod, 877 Dorchester St., Montreal.

Society for the Promotion of Engineering Education. Secretary, Prof. M. S. Ketchum, University of Colorado, Boulder, Colo.

American Society for Testing Materials. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Municipal Improvements. Secretary, George W. Tillson, Room 12, Municipal Building, Brooklyn, N. Y. Annual meeting, Sept. 5-9, Montreal.

Association of Railway Superintendents of Bridges and Buildings. Secretary, S. F. Paterson, Concord, N. H.

American Railway Engineering and Maintenance of Way Association. Secretary, L. C. Fritch, 1562 Monadnock Block, Chicago.

American Water-Works Association. Secretary, J. M. Diven, Charleston, S. C.

American Foundrymen's Association. Secretary, Richard Moldenke, P. O. Box 432, New York.

Engine Builders' Association of the United States. Secretary, J. L. Lyle, 39 Cortlandt St., New York.

American Public Works Association. Secretary, W. H. Flint, Chattanooga. Annual meeting, Chattanooga, Aug. 30-31.

THE AMERICAN SOCIETY FOR TESTING MATERIALS.

The eighth annual meeting of the American Society for Testing Materials was opened on Thursday afternoon of last week at Atlantic City, N. J. The annual report of the Executive Committee showed that the membership increased during the past year from 490 to 677; in this connection it should be added that the attendance at the meeting was about 200. The number of standing technical committees has been increased from eleven to eighteen. The important feature of the report refers to the relations of the Society with the International Association for Testing Materials, and reads as follows:

"The relations of the Society with the International Association have been confined during the past year, as usual, to routine correspondence. Three months ago the unexpected and unwelcome news was received that the International Council had decided for the third time to postpone the next Congress for another year. In pursuance of the action taken at the Third Congress, convened in Buda-Pesth, in 1901, the Fourth Congress should have been held in 1903. The first postponement till 1904 was based on the ground that this would give the committees a better opportunity to complete their labors. The second postponement of the Congress which was to have been held in St. Petersburg, Russia, in 1904, was attributed to the war in the Far East. It was later decided to hold this Congress in Brussels in 1905, but owing to circumstances concerning which your Executive Committee has received no definite information, it has been determined to postpone this Congress for a third time, and it is now announced that it will be held in Brussels in 1906.

"During the four years that have intervened since the last Congress the members of the Association have received practically nothing beyond the minutes of the Third Congress and the minutes of the annual meetings of the Council, and these only after long delays. Not even a list of members has been issued during that period, a period during which our own remittances have aggregated nearly two thousand dollars. Nor is it clear, at least from the American standpoint, why the causes that operated to induce the abandonment, first, of the proposed St. Petersburg Congress; second, of the proposed Brussels Congress, should have precluded the holding of a congress in some other city and country during either of these years.

"According to recent announcements the Council proposes to commence this year the publication of the reports of certain committees and referees in English, German and French, and to distribute these among the members free of charge, in whatever language may be preferred. A list of members, correct until June 1, 1905, is also promised.

"It is becoming more and more evident that the feeling of many of our members toward the International Association is one of growing indifference or dissatisfaction. It is believed, also, that the great majority of new members have joined the American Society wholly irrespective of any expected advantage incident to their membership in the International Association. In the judgment of the Executive Committee, the time has come to consider whether in fairness to the interests of the American Society, membership in the International Association, with attendant dues, shall continue to be a *sine qua non* to membership in the Society. It is believed that this should properly be left to the free choice of the individual members, and it is accordingly proposed to amend the by-laws.

"The practical effect of the proposed amendments would be to increase the yearly revenues of the Society from dues about a thousand dollars on the basis of the present membership, and to increase, by $1.50 per annum, the dues of those members only who may wish to continue their connection with the International Association. This would greatly hasten the day when the Society will find itself on a strictly self-sustaining footing, that is to say, entirely independent of subscriptions or contributions in any form. It is believed to be the unanimous sentiment of the membership that such a condition should be realized as speedily as possible.

"If the third postponement of the Congress could have been anticipated, some such action as is now proposed would doubtless have been recommended a year ago, and was, in fact, under consideration by the Executive Committee at that time. The matter was held in abeyance merely to await the outcome of the Congress announced for this year. The first notice of the third postponement was received three months after the beginning of the present fiscal year. Under these circumstances the Executive Committee decided to withhold all remittances to the International Association on account of dues for the current year, pending an expression of the sense of the membership at large at the annual meeting, and eventually by letter-ballot, on the above proposed amendments of the by-laws, and in case these should be favored, on the question of limiting the remittances for the current fiscal year, beginning on January 1, 1905, to the dues of such members only as may decide to maintain their connection with the International Association. The dues of the remaining members would, in that case, be refunded according to individual option.

"The conclusions of the Executive Committee on this important subject are offered as the result of the most careful deliberation, and in the full realization of their possibly far-reaching effect on the future, both of the International Association and the American Society. It is believed, however, that the time has come to face the issue squarely."

This statement aroused considerable discussion; there was unanimity of opinion that the American members of the International Association received practically nothing whatever from it, and the notorious difficulty of obtaining any acknowledgement of remittances or important letters to the Association was very plainly discussed. It was ascertained by a straw vote that probably a third of the members of the Society would continue their memberships in the International Association if the proposed amendments were adopted; this would cut down the American membership in the Association to about 200. The general trend of opinion among the speakers seemed to be that the present contributions to the Association were productive of no return and should be stopped, but great care should be taken to avoid any action intimating that the Society was not in hearty sympathy with the avowed objects of the Association. It was finally decided to submit to letter-ballot the proposed amendments, and some other features of the relations of the two organizations.

The Committee on Standard Methods of Testing, recently appointed, had not been able in the time at its disposal, according to Professor Lanza, its chairman, to do much more than prepare an outline of its work, which is very comprehensive. Chairman Kreutzpointner, of the Committee on Uniform Speed in Commercial Testing, presented a preliminary report on a number of tests indicating that a 6-in. speed would probably be as satisfactory as one of 3 in. Prof. Ira H. Woolson, chairman of the Committee on Fireproofing Materials, reported that the short time since its appointment had not permitted any work to be done. Dr. Herman von Schrenck, chairman of the Committee on Standard Specifications for Grading Structural Timber, read a preliminary report on the necessity of such specifications and outlined the scope of the work the committee was undertaking.

Second Session.—The second session, on Thursday evening, was held jointly with the Society for the Promotion of Engineering Education. It was opened by Dr. Charles B. Dudley, with his presidential address, the theme being the "Testing Engineer," on which nobody else in this country is so well qualified to speak. It is printed elsewhere in this issue. He was followed by Prof. W. K. Hatt, with a paper describing the course of laboratory instruction in testing material at Purdue University, and one by Prof. G. L. Christensen on the course in the properties of materials at the Michigan School of Mines. These papers were discussed jointly and the indication they gave of the character of the instruction in the properties of the leading engineering materials was commended by several speakers. In his remarks Dr. Dudley took occasion to mention the tendency toward quantity rather than quality in modern technical education, and other speakers referred frequently to it. Prof. Wm. Kent pointed out, however, that in some subjects he had found it impracticable to teach broad principles except by insisting on details.

The final paper of the session, by Dr. J. A. Holmes and Mr. Richard L. Humphrey, on the plan and scope of the proposed investigation of structural materials under the auspices of the U. S. Geological Survey, was not in form for presentation at that time, but the substance of it was explained by the authors. The Geological Survey has done much co-operative work in the past, and the investigations at St. Louis are of a similar character. It is not intended to duplicate the experiments conducted elsewhere, but rather to extend and supplement them with others of a character suited for government research work.

Third Session.—The meeting of the Section on Cement, on Friday morning, was opened with the report of the Committee on Standard Specifications for Cement. Prof. George F. Swain, the chairman, stated that there were no reasons for suggesting any changes in the specifications. This condition was referred to later by Mr. R. W. Lesley, in presenting a paper on the British standard specifications. The American specifications were the result of many years' work of several technical societies, aided by various laboratories, collegiate and private. The work was done slowly but satisfactorily. The British spcifications were prepared by representatives of even more interests, but they were published after only a few months' consideration, and have already aroused great criticism, which seems to be increasing rather than decreasing.

The collective exhibit of Portland cement products (see Eng. Record, Oct. 29, 1904, current news supplement) made at St. Louis under the direction of the Association of American Portland Cement Manufacturers was discussed by Mr. R. L. Humphrey, with the assistance of lantern slides. He explained at considerable length the tests of reinforced concrete beams made at the exhibit and also the research work to determine the value of mortar sands from various parts of the country and of different aggregates.

Normal tests for the consistency of neat cement were discussed at considerable length. The subject was introduced by a brief paper by Mr. R. S. Greenman, of the New York State Laboratory, who stated that he had found the test prescribed in the Society's standard specifications rather unsatisfactory with some of the samples sent to his office. This was acknowledged to be the case by most of those who took part in the discussion, but nobody had any suggestions for a better test. The fact was brought out that tests made in the standard way on the same samples of cement by many laboratories agreed surprisingly well, and it was not until this fact had been established that the test was definitely proposed by the committee on standard specifications.

A description of an inexpensive mold for concrete compression test pieces was read by Messrs. Clifford Richardson and C. N. Forrest; this paper is printed elsewhere in this issue. The mold prepares a cylindrical test piece 6 in. in diameter. This diameter was chosen as being satisfactory for most commercial purposes and well within the limits of the machines available in most laboratories. Prof. Hatt pointed out that this diameter was hardly large enough for testing concrete in which the pieces of the aggregate were of large size, and he suggested 8 in. as better on this account, although cylinders of such dimensions would require a more powerful testing machine. Mr. W. P. Taylor stated that while the cylindrical mold enabled the concrete to be rammed better than a cubical mold, if the work is done in the usual way, by the use of special rammers the cubical molds could be filled very satisfactorily.

A paper on impact tests of asphalt paving mixtures, by Messrs. Clifford Richardson and C. N. Forrest, was presented briefly by the former. It is printed elsewhere in this issue and is particularly important as showing the increased regard for the impact test for certain materials, although the estimation in which it is held for other materials is gradually falling. A paper on slow-pulling, early-stage rotary Portland cement as compared with the ordinary product developing high early strength, was read by Mr. W. A. Aiken and is printed elsewhere in this issue. It presents in concise form the results of the greatest number of long-time tests ever made in one laboratory under the specifications of a single consumer. Prof. Ira H. Woolson presented a paper giving the results of experiments made by two Columbia undergraduates to determine the effect of high temperatures on concretes made with trap and limestone as aggregates. The tests showed that concrete is a good non-conductor of heat and is not seriously affected by high temperatures, unless they are prolonged. In the discussion, Mr. L. C. Wason stated that he was accustomed to add 1 in. on each side of his columns of reinforced concrete in order to provide for any sealing of the surfaces during fires. The tests described by Prof. Woolson indicated that this was ample.

The meeting of the Section on Preservative Coatings was held at the same time as that of the Section on Cement. It was opened with a report of the Committee on Preservative Coatings for Iron and Steel, which has at last been definitely organized for work. A year ago the members could not agree on any course of action, but since then it has commenced systemmatic work to discover laboratory tests which will indicate the protective value of a paint under certain known conditions of exposure. For this purpose it has organized sub-committees on standard methods of conducting field and service tests, on the permeability and permanence of paint films, and on the preparation of iron and steel surfaces for painting. The idea is that the service tests act as a check on the field tests, that laboratory tests as to permeability should be accepted as of value only when in accord with field and service tests, and that the permanency of a film in its impermeability and other protective qualities should throw light on the results obtained by field and service tests.

The Committee on Standard Tests for Lubricants was so recently appointed that only progress could be reported at this meeting.

There were two topical discussions at this session, on standard specifications for preservative coatings for steel and on painting steel cars. It is almost needless to say that the views expressed on these subjects were so divergent that any attempt to give an abstract of them would probably do injustice to the speakers. Two important papers were read, one by Mr. Louis H. Barker, on the protection of iron and steel structures by means of paper and paint, and the other by Mr. G. W. Thompson, on the proper methods of conducting paint tests. The latter will be printed next week, while the substance of the former was printed in these columns about a year ago.

Fourth Session.—This session, on Friday afternoon, was given up entirely to a report of the Committee on Standard Specifications for Iron and Steel. It presented suggested changes in five specifications. The first of these was for structural steel for bridges, and the changes were intended to harmonize the specifications of the Society and those recently adopted by the American Railway Engineering and Maintenance of Way Association. This was not effected, but substantial agreement was obtained. The second set of specifications was for steel rails, and the object of the revision was to have the Society adopt the specifications of the American Railway Engineering and Maintenance of Way Association, with modifications. The discussion on this subject was the most animated of the convention, and related very largely to the drop test. The Association mentioned required a drop test from each blow of steel, the test piece to be taken preferably from the top of the ingot. The Committee proposed to insist in the Society's specifications on taking the test piece from the top of the ingot, but to make tests of every fifth blow only. There was not much objection to adopting this rule concerning the test piece, but there was a clash of opinion concerning testing every fifth blow. Representatives of rolling mills claimed that to test every blow caused too much delay in manufacture and was wholly needless for rails carrying many classes of traffic. The Society's object was to prepare specifications of a general nature, and not to suggest for such a purpose the requirements for rails on the main line of an important trunk road. In the course of the discussion Mr. Robert Job read a very interesting paper on some causes of failure of rails in service, which will be printed next week. Dr. Dudley also mentioned the impossibility of securing only perfect rails under the specifications of the Pennsylvania R. R., and mentioned the great strain put on a resident engineer for a month or so after new rails are laid down. It was finally decided to refer all the proposed changes back to the committee, with power to act.

In explanation of this action it should be stated that on each of the Society's committees it is the intention to have an equal representation of purchasers and manufacturers, so that the committee's discussions will be fair to all interests. The members of the Committee on Standard Specifications for Iron and Steel, for example, are William R. Webster, Edgar Marburg, Charles S. Churchill, James Christie, F. H. Clark, J. Allen Colby, John Sterling Deans, P. H. Dudley, J. E. Greiner, Prof. Lanza, S. S. Martin, Richard Moldenke, L. R. Pomeroy, Joseph T. Richards, C. C. Schneider, J. P. Snow, J. A. L. Waddell, Samuel Tobias Wagner, Max H. Wickhorst, H. V. Wille, American Steel & Wire Co., Bethlehem Steel Co., Cambria Steel Co., Carnegie Steel Co., Central Iron & Steel Co., Colorado Fuel & Iron Co., Franklin Institute, Robert W. Hunt Co., Illinois Steel Co., Jones & Laughlin Steel Co., Lukens Iron & Steel Co., National Tube Co., Osborn Engineering Co., Pennsylvania Steel Co., Reading Iron Co., John A. Roebling's Sons Co., Shelby Steel Tube Co., Standard Steel Works and R. D. Wood & Co.

Fifth Session.—This session, on Saturday morning, opened with a brief consideration of the portion of the committee report left over from the previous session. This was referred back to the committee with power to act. Mr. H. V. Wille, of the Baldwin Locomotive Works, then read a report of the Committee on Standard Specifications for Staybolts. In it a certain method of manufacture was recommended, which aroused some discussion from members opposed to putting in specifications any requirements except those relating to quality. They held that when they fixed the quality they wished, the manufacturer should be permitted to secure it in any way he pleased. The report was finally ordered sent out for letter ballot. Mr. Wille then read a paper on the influence of methods of piling staybolt iron on vibratory tests. Considerable discussion on such tests followed, several members stating that it was impossible to get concordant results from test pieces from the same bar of iron in the same machine. The Committee on Standard Specifications for Cast Iron and Finished Castings reported specifications for car wheels and gray-iron castings, which were ordered sent out for adoption or rejection by letter ballot.

Three papers were then presented, one of them, on hard cast iron, by Henry Souther, being read by title. Dr. Richard Moldenke then read a rather general comparison of standard methods of testing cast-iron in this country and abroad, which brought out an interesting discussion concerning the length of test pieces. The session was closed with a paper by Mr. E. Stuetz, on the thermit process in American practice. With the aid of a lantern he showed the method of welding locomotive frames and drivers, parts of vessels, rails and other parts. In the discussion, the use of thermit in producing suitable foundry mixtures was mentioned by several speakers.

Sixth Session.—At this meeting, on Saturday afternoon, the report of the Committee on the Magnetic Testing of Iron and Steel was read by title, as it was not entirely completed, and a paper by Mr. P. H. Dudley was similarly presented. Mr. L. W. Page, chairman of the Committee on Standard Tests of Road Materials, presented a report on toughness tests for macadam rock and on a standard method of analysis of bituminous paving materials.

In the consideration of macadam road materials, toughness is understood to mean the power possessed by a material to resist fracture by impact. In testing macadam rocks under impact, it has been found best to apply a number of blows of successively increasing energy and note the blow causing failure. The following test involving this principle was therefore recommended for determining the toughness of rock for macadam road building:

1.—Test pieces may be either cylinders or cubes, 25 mm. in diameter, and 25 mm. in height, perpendicular to the cleavage of the rock. Cylinders are recommended as they are cheaper and more easily made.

2.—The testing machine shall consist of an anvil of 50 kg. weight, placed on a concrete foundation. The hammer shall be of 2 kg. weight, and dropped upon an intervening plunger of 1 kg. weight, which rests on the test piece. The lower or bearing surface of this plunger shall be of spherical shape, having a radius of 1 cm. This plunger should be made of hardened steel, and pressed firmly upon the test piece by suitable springs. The test piece should be adjusted so that the center of its upper surface is tangent to the spherical end of the plunger.

3.—The test should consist of a centimeter fall of the hammer for the first blow, and an increased fall of 1 cm. for each succeeding blow until failure of the test piece occurs. The number of blows necessary to destroy the test piece is used to represent the toughness.

This test will be sent out for letter ballot in the usual way.

The recommended method for analyzing bituminous paving materials consists in treating a definite quantity of the material under examination with a specified amount of carbon bisulphide at ordinary temperatures, allowing this to stand undisturbed for a sufficient time to permit of a subsidation of the insoluble matter. The solution is then decanted off into another receptacle and the residue again treated with the solvent.

After standing a second time for subsidation, the two solutions are filtered through a Gooch crucible, fitted with an asbestos plug. The filtrate is then evaporated down and the residual bitumen burnt off and the weight of the ash added to that of the residues in the receptacle and on the filter. The difference between the weight of the substance taken and the combined weight of the residues, is the bitumen extracted. It was further recommended that this method be applied to the extraction of bituminous paving materials with naphtha. This method had been agreed upon by the committee; there yet remains to be described minor details relating to the character and quantity of materials used in making the tests. It was accordingly decided to refer the test back to the committee for further consideration.

A report from the Committee on Boilers was read, in which reference was made particularly to the necessity of thoroughly overhauling the U. S. Marine Service requirements, which can only be done by congressional action. The committee requested the Society to join other organizations in securing such legislation. In the discussion some objection was raised to committing the Society to action on any subject outside its immediate field, and finally the matter was referred to the Executive Committee.

Mr. R. D. De Wolf read a paper on specifications for cotton tapes for electrical purposes. It explained those features of a tape which must be specified in order that the manufacturer will have definite requirements to work to. The session closed with a paper by Mr. Robert A. Cummings on a testing machine for applying uniform loads to large reinforced concrete beams. It consists of a heavy wooden beam supported at each end by a wooden A frame. From this beam the concrete beam to be tested is hung by wire ropes. Three hydraulic rams are carried by the wooden frame and their plungers press downward on the centers of three horizontal equalizing beams. The six ends of these beams press downward in turn on the centers of six more equalizing beams, and the latter transmit the pressure in a similar fashion to a third tier of twelve beams. The latter press against the concrete beam at 24 places, giving a practically uniform load. The author described the details of the machine, the method of calibrating it, and gave lantern views showing the apparatus and a number of beams tested by it.

During the convention it was voted to organize three new committees, one on waterproofing materials, a second on steel springs, and a third to formulate plans for research work on the properties of structural steel.

In closing this brief review of an important convention it should be stated that much of the credit for the successful manner in which the really enormous programme was covered was due to the president and secretary. Dr. Dudley's ability as a presiding officer is unique, for he not only keeps the discussions strictly to the subject and prevents any lagging, but he also inspires those in attendance with interest in every topic presented. Prof. Marburg's work as secretary is not so conspicuous, but the smoothness with which every part of the convention moved shows to those who have had experience in convention management that a great deal of planning and arranging of details had been attended to very carefully. No small part of the success of this and previous conventions of the Society have been due to these two officers, and it is gratifying to note that all members unite in a desire to retain their services indefinitely.

A beautifully executed souvenir brochure has been issued by the R. D. Cole Mfg. Co., Newnan, Ga., in honor of the fiftieth anniversary of the founding of the company, by R. D. Cole, one of the pioneers in the iron and machinery business in the South. The connection of this company with some of the mechanical details of the civil war is historic. The history and personnel of the company and the present scope of the work carried on are referred to. The products include stationary boilers and engines, saw mill and grist mill machinery, standpipes, tanks, structural work, and similar machinery and steel products.

STATEMENT OF JOHN F. WALLACE CONCERNING HIS RESIGNATION.

The primary causes which led me to tender my resignation as chief engineer of the Isthmian Canal Commission were underlying and fundamental, and I must emphatically resent the charge that my motive in leaving the work was a financial one.

A careful consideration of the entire subject had brought me to the decision that I should disconnect myself with the work at the earliest possible date that it could be done without embarrassment to the administration or injury to the work. It is unnecessary to state the reasons for this decision, except that in fairness I should say that they involve no criticism of any act of the President or the Secretary of War.

My final decision was arrived at as the result of the six days' uninterrupted thought which I was able to give the subject in all its bearings during my voyage from New York to Colon in May. Furthermore, I had pledged myself to my family to give the matter of my resignation as chief engineer, or of any position which would require my continuous residence on the isthmus, serious consideration.

It was at this psychological moment that I received a cable message from New York offering me a business opportunity which I was bound to consider. I, therefore, immediately cabled the Secretary of War requesting a conference, and arrived in New York for that purpose on Thursday, June 22.

In the meantime I had addressed a letter to the Secretary, in which I confirmed the request for an interview, and also requested my annual leave of absence, which was part of my original understanding with the Isthmian Canal Commission, and which I had requested from Admiral Walker in March, to take effect at our mutual convenience some time later in the season, which request, however, was not complied with or answered, owing probably to the sudden change made in the Commission on April 1.

On my arrival in New York I was met by Mr. William Nelson Cromwell, who stated that he was delegated by the Secretary to arrange for a personal interview with me, and asked me if I would meet him at the Manhattan Hotel at 10 A. M., Sunday, June 25. While Mr. Cromwell treated me with the suavity and courtesy for which he is noted, he endeavored to draw from me my reasons for desiring to see the Secretary. I told him frankly that I did not consider it would be proper for me to discuss the matter in advance of my interview, and I also requested him to arrange for me with the Secretary that the interview should be absolutely private, and that no one but the Secretary and myself should be present.

On arriving at the Manhattan on Sunday I was met by Mr. Cromwell, who ushered me into the Secretary's private apartment, accompanied by my son. Assuming that arrangements had been made for a strictly private interview, my son withdrew, expecting Mr. Cromwell to do the same. However, the Secretary, in a rather peremptory manner, directed Mr. Cromwell to remain. This action, of course, caused irritation and apprehension on my part that the interview would be unpleasant and unsatisfactory, and the irritation under which the Secretary was evidently laboring had a tendency to prevent that calm and dignified consideration of the question in all its bearings which should have been given it.

If the Secretary understood me to say that I had accepted a position in New York, he labored under a misapprehension. I did state to him that I desired to accept one, but under such circumstances and conditions and at such time as would cause the least embarrassment to the administration and the least injury to the work, and that I was even willing to go to the extent of remaining for an indefinite time on the Commission, should he desire my counsel and advice in arranging for the change, assisting in preparing plans for submission to the Advisory Board of Engineers in September, or in the further consideration of the question by the administration or Congress during its next session.

Much to my surprise, he indignantly spurned my suggestion and took the position that I was compelled under what he called my contract to remain in charge of the isthmian canal, regardless of circumstances or conditions, until the completion of the work, and spoke in such a manner as to outrage my feelings to such an extent that further discussion of the reasons for my action was out of the question.

I did not seek the position of chief engineer of the Isthmian Canal Commission, and, considering my salary as general manager of the Illinois Central Railroad Company and my other sources of earnings, my financial condition was not improved by my acceptance of the position, and it was with the greatest reluctance that I did so.

While it was my own expectation that I should continue my connection with the work, it did not occur to me that I was not free to withdraw if justice to myself and my family and to my reputation as an engineer required me to do so. It was not only my right, but my duty, to give the matter most careful consideration in all its bearings, considering not only the general situation as it affected the work, but my family, personal and business relations, and all the various factors entering into the problem, and I could not concede the right to the Secretary of War or any one to dictate my decision. The only debatable questions were the details as to putting my decision into effect, and, while I stated to the Secretary what my desires were, I told him that I was perfectly willing to conform to his wishes as far as possible as to the time and manner of my withdrawal.

It was this suggestion to which he chose to refer as a "dicker." To that statement I naturally took exception, particularly as he stated that he did not care for any reports that I might make, summarizing and analyzing the results of a year's hard work on the isthmus; also that he did not value my counsel and advice, and that the only service he desired was that of a constructing engineer on the isthmus.

No intimation of friction between the Secretary of War and myself would ever have become public if it had not, accidentally or otherwise, been given out by the persons in attendance at the conference on Sunday other than myself; and I desire to state emphatically, and the representatives of the press will bear me out, that I have refused absolutely, either directly or indirectly, to be interviewed, and have remained silent under the inuendoes which have been daily published since the conference, and would not have made even this statement at this time if it had not been for the severe strictures contained in the published statement of the Secretary, which I consider unjust and uncalled for and which could serve no useful purpose.

In regard to the situation at Panama, at no time during the progress of the work could my relations have been severed more opportunely than now and with less damage to the work. A complete organization of departments and bureaus has been effected. W. E. Dauchy, a gentleman of high engineering attainments, who has been chief engineer of the Chicago, Rock Island & Pacific Railroad Company, and who had occupied the position of division engineer in charge of the Culebra division, was, upon my leaving the Isthmus, placed in charge of the work as acting chief engineer, he having occupied a similar position during my absence from the Isthmus at the call of the Secretary during the month of April and having satisfactorily conducted the work through the demoralization attendant upon the change in organization.

The only work which can be performed until after Congress at its next session shall take some decided action is the general increase in the organization and the addition of units of machinery along a well defined plan, which Mr. Dauchy thoroughly understood. The simple work of excavating at Culebra and preparing for further excavation are the only things which could be done, pending a final decision from Congress. The only possible benefit that my personal service as chief engineer could have been to the work was such as might be due to the purely personal element, which would have been largely supplied by my continuance with the work in an advisory capacity. As far as the actual engineering and construction work was concerned, Mr. Dauchy was fully as capable as I.

Despite all of the discouragement and obstacles which have surrounded this work, as the Secretary knows and has practically stated in his letter, I endeavored faithfully and vigorously to perform the duties of my office, and have never complained or criticised my superiors, or any one connected with the work; and, as stated in the Secretary's communication, I have never requested additional emoluments or asked any favors of a personal nature, and any suggestions which I may have made, as his statement will bear me out, have been made because I considered them necessary for the increased efficiency of the work.

The reorganization of the work in April was not considered ideal, but as it was such a decided improvement over the existing condition of affairs and seemed to be all that could be done under existing laws, I gave it my hearty approval.

I have made no criticism of personnel or individuals, but do believe that the obstacles due to the governmental methods required by existing laws are so serious that they will have to be eliminated if the American people are to see the Panama canal constructed in a reasonable time and at a moderate cost.

My only desire in this statement has been to protest against what I consider the unjust denunciations of the Secretary, and fully to inform my personal friends and professional brethren who have been familiar with my career of the essential facts relating to this matter. I emphatically disclaim all responsibility for the various statements recently published alleged to have been made by so-called friends.

Comparative frictional tests on Hyatt roller, cast iron, bronze and babbitt bearings are discussed in a pamphlet issued by the Hyatt Roller Bearing Co., Harrison, N. J. These tests were made by Prof. A. L. Williston, of Pratt Institute, Brooklyn, N. Y., in order to determine for a certain purchaser the type of bearing offering the least frictional resistance to the revolving member, and the results are overwhelmingly in favor of the flexible roller bearing. The details of the test are given in full in the pamphlet.

WATER SUPPLY BY COMPRESSED AIR LOS ANGELES, CAL.

The water supply of Los Angeles has, in the past, been received by gravity, only a few higher parts of the city being supplied by pumping into the mains. The growth of the city, however, has made an additional supply necessary and a pumping plant is to be installed in the southwestern part of the city near Slauson Junction, where wells have been bored to water-bearing strata lying 60 to 200 ft. below the surface. As these wells are too deep to permit of their operation by pumping engines located on the surface and as it was considered commercially impracticable to pump them by deep-well pumps with long plunger rods, and, again, very costly to excavate pumping stations underground near the water level, it has been decided to operate them with compressed air.

The twelve wells will discharge into a common reservoir, from which the water will be forced by a pumping engine into the city water mains. The water in the wells at present stands about 60 ft. below the surface, but, as has been found in irrigation work in California, the ground level of subterranean water supplies is apt to be lowered considerably by continuous pumping, and the compressor has, therefore, been designed to pump, if necessary, from a much lower level, being guaranteed to deliver 2,000 cu. ft. of air per minute against a pressure of 100 lb. The contract for the compressor was awarded to the Baker Iron Works, of Los Angeles, who are local agents of the Laidlaw-Dunn-Gordon Co., of New York. The machine which will be installed is of the same type as that furnished by this company to supply all the compressed air used at the St. Louis Exposition, and received a Grand Prize. The air valves of this compressor are different from those of other compressors in that they combine the quietness and high-speed qualities of mechanically-moved valves with the elasticity of poppet discharge valves, the valves being controlled by what is known as the Cincinnati air-valve gear. The Los Angeles machine will be of the two-stage type; that is, the air will be partly compressed in a large cylinder, after which it will pass through a cooler, where its temperature will be reduced by passing over tubes containing cold water, to a high-pressure cylinder, where the compression will be completed. The steam engine driving the compressor and forming, in reality, a part of it, the steam cylinders working on the same piston rods, is also compounded, the steam expanding first in a high-pressure cylinder, after which it passes to a receiver, where it is dried and reheated by high-pressure steam in pipes, after which it finishes its expansion in the low-pressure cylinder. The steam is then condensed in a surface condenser and returned to the boiler through reheaters by the boiler-feed pumps. The entire machine is supplied with oil from one central tank and the oil going into the steam cylinders is afterwards removed by a separating device placed in the exhaust pipe. The automatic governor controls both the pressure of the air delivered and the speed of the engine; that is, if the consumption of air is reduced by the shutting off of wells, the engine slows down, maintaining a constant pressure, while if one of the air pipes should break, the speed governor would prevent the engine from running above a certain speed.

HAULING HEAVY GIRDERS.

Four triple-web plate girders 41 ft. long, 7 ft. deep and 3½ ft. wide were recently transported in Chicago about a mile from the Michigan Ave. freight yards at the foot of Water St. to the Majestic theater, on Monroe St., between State and Dearborn Sts. Each girder weighed about 108,000 lb. and was shipped from Pittsburg with its web horizontal, loaded on a steel gondola car. They were transferred in Chicago to common flat cars and the ends successively jacked up enough to permit the insertion under their flanges of horizontal greased T-rails having their outer ends supported on timber cribbing built up on both sides of the reach and between and beyond the wheels of a special four-wheel wagon. The girder was pushed across the cribwork until it was directly above the wagon frame and was slightly raised again by the jacks, releasing the skids and cribbing, and then lowered to bearing on the bolsters. The wagon was of special construction, built by the J. C. Pennoyer Co., and had 925-lb. wheels with wood spokes, 5½-in. steel axles and 6 x 1½-in. tires. The girders were transported at night to avoid obstructing the heavy street traffic, and one and a half days were required to unload and haul each of them. Six men transferred the girder from the car to the wagon and sixteen horses were required to haul it over the rough roads and up the steep grade. After this was surmounted twelve horses sufficed to haul it to the theater without any accident except the breaking of the wagon tongue while passing around a corner. The girders were made by the McClintic-Marshall Construction Co., and were hauled from the railroad to the theater by the J. C. Pennoyer Co.

AN ELECTRICALLY DRIVEN AIR COMPRESSOR FOR RAILWAY SHOP SERVICE.

The requirements of modern railway shop practice demand the supply and distribution of compressed air for pneumatic tool service and the air compressor is now a standard feature of the equipment of repair shop power plants. Where electric power is commercially available the tendency is toward the use of an electrically driven air compressor and of modern practice along these lines a good example is to be seen in the boiler repair shop of the new Baltimore & Ohio R. R. shops, at Baltimore, Md.

The machine is one of the standard types built by the Ingersoll-Sergeant Drill Co., of New York, belonging to the class of compressors known by the makers as "JC," and is a duplex two-stage machine designed to secure the best economy, both in the compression process proper and in the mechanical application of power to this process. The entire machine is suported on a sub-base of box pattern extended to receive the driving motor. Within this sub-base and directly beneath the air cylinders, is the intercooler, of a design which provides a maximum cooling effect while avoiding leakage due to unequal expansion of parts. Cooling water circulates through a nest of tubes, extending within the sub-base, about which the air from the low-pressure cylinder passes; by opening a cover at the side of the base, the entire nest may be withdrawn bodily.

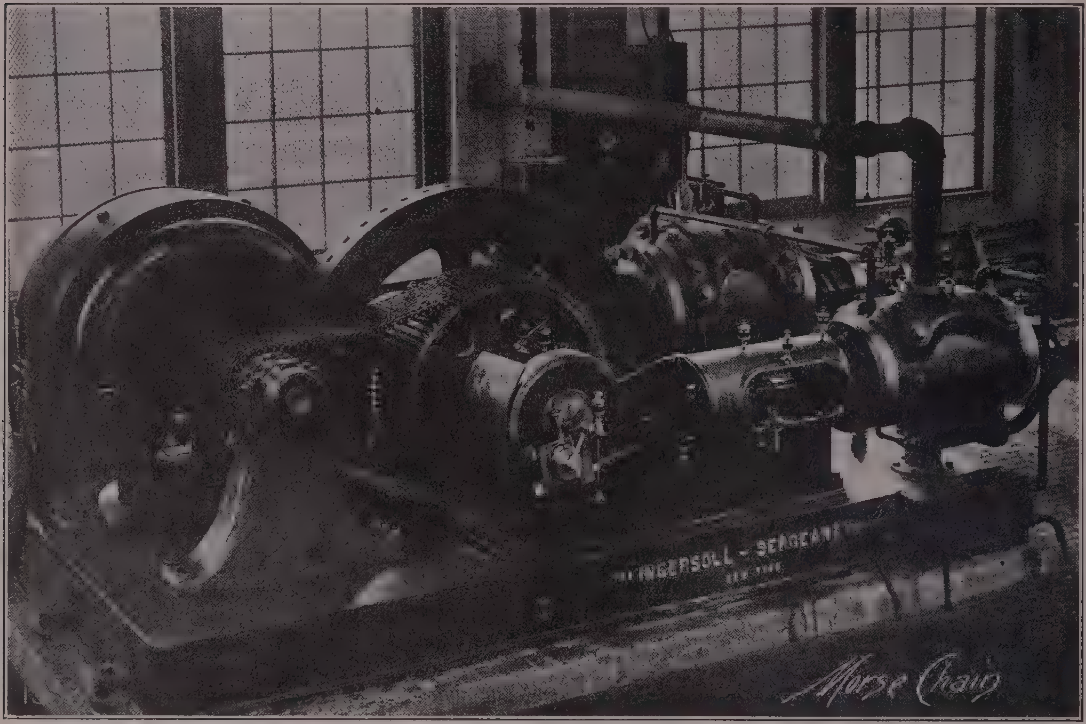
The air cylinders are 22¼ and 14¼ in. in diameter by 14-in. stroke, both fitted with the new Ingersoll-Sergeant piston inlet valves and mushroom discharge valves. Automatic regulation of power consumption to air demand is secured by means of a choking controller on the low-pressure air intake, throttling the air supply as the demand for compressed air diminishes. The action of this device is to vary the effective piston displacement of the compressor under varying loads. The pressure delivered is 80 to 100 lb., within which limits the controller can be set to maintain any desired pressure practically constant. At the rated speed of 120 r.p.m. the free air capacity of this compressor is 720 cu. ft. per minute, compressed to the terminal pressure of 100 lb.

One of the most interest features of the machine is the use of the silent chain drive, made by the Morse Chain Co. While neither the gear-drive nor the direct-connection drive are applicable under conditions such as these, the former on account of extreme noise and general inefficiency and the latter on account of imposing too high piston speeds, still the chain drive proves convenient, giving the positive drive feature of the former and the flexibility of the belt. One of the advantages in this case was the compactness possible with this drive, the distance between sprocket centers being 48 in. The chain used is a large one, 13 in. wide with a 1½-in. pitch, and the sprockets have 21 and 87 teeth respectively, reducing the speed from 500 r.p.m. at the motor to 120 at the compressor shaft. The chain is operated at a linear speed of 1,310 ft. per minute. A sheet steel guard is used to enclose and protect the gears and chain transmission.

The motor is a six-pole, General Electric, direct-current machine, rated at 125 h.p. at 500 r.p.m., and operates at 500 volts pressure. It is of the semi-enclosed type, with outboard bearing, and solid iron covers close the upper half of its end shields, keeping out flying chips and falling dirt while still leaving openings below for air circulation.

A feature of the entire unit of special interest is the care exercised in providing covers for wearing parts, protecting them so far as possible from pervaling dust of a boiler repair shop.

The electrical controlling devices include a polished black slate tablet board, carrying a double-pole, quick-break fused knife switch and a double-pole, overload circuit breaker. In addition, there is provided a multiple switch hand starting and automatic releasing rheostat in the motor circuit.



AN ELECTRICALLY DRIVEN AIR COMPRESSOR WITH MORSE CHAIN CONNECTION.

THE COMBINED REFUSE DESTRUCTOR AND ELECTRIC PLANT AT HACKNEY.

The British technical press has recently contained numerous references to a plant at Hackney which is a combination of an electric central station and a refuse destructor. It furnishes 240-volt current on the three-phase system, and has a total capacity of 3,372 kw. The boiler-room contains four Babcock-Wilcox boilers, each of 2,852 sq. ft. heating surface, evaporating 10,000 lbs. water per hour, with superheaters of 389 sq. ft; also two similar boilers, each of 4,020 sq. ft., evaporating 4,000 lbs. per hour, with superheaters of 452 sq. ft.; also in destructor house three Babcock-Wilcox double-drum boilers of 2,852 sq. ft.; working pressure of all the boilers, 210 lbs. Over each boiler is a cylindrical water purifier for steaming the water, in addition to separate softening plant. The feed-water is heated by a Green's economizer of 288 tubes, the scrapers of which are driven by a motor through a Renold chain. Coal is stored in bunkers, to which it is conveyed by automatic conveyor, and is fired by chain grate stokers driven by a Crompton motor of 10-h.p. The engine-room contains two Willans triple-expansion, single-acting engines of 500 i.h.p. each, run at 300 r.p.m., two Bellis triple-expansion double-acting engines of 1,000 i.h.p. each, and one Belliss engine capable of giving 2,150 b.h.p. at normal and 2,650 b.h.p. at maximum load when running at 165 r.p.m., with steam of 175 lbs. pressure at stop-valve. The engines are all intended for superheated steam of 500° F. The smaller engines exhaust into a common condenser, and the larger into condensing plant with cooling tower. Each engine drives directly. The Willans engines each drive two dynamos rated at 150-kw. each, with an overload capacity of 165-kw. One of the Willans engines drives in addition a booster of 72-kw. output. The two Belliss engines are each coupled to two dynamos rated at 300-kw. each at full load, with an overload capacity of 330-kw. for two hours. The large Belliss engine is coupled to a 10-pole dynamo having a normal full load capacity of 1,500-kw. at 490 to 560 volts. There is also a booster of 50-kw. driven by a motor. All the dynamos are shunt-wound, generating at 240-275 volts. The large dynamo, unlike the others is connected between the outers of the three-wire system. The feeders and distributors are all triple-concentric, paper-insulated, and lead-covered, laid in earthenware troughs 2 ft. 6 in. deep under the footways, and in iron troughs 3 ft. deep under the roadways. The switch gear is divided into two sections by a brick wall, against which on one side the generator panels are built, and on the other side the feeder panels. The station is equipped with a battery of 304 Tudor cells, capable of giving 600 amps. for four hours, or 1,450 amps. for one hour at 550 volts. The price charged is 4d. per unit for lighting, with 10 per cent. discount to long-period consumers, and 2d. per unit for power for the first 1,000 units per quarter, and then 1½d. per unit for all consumption in excess of that quantity. The destructor consists of twelve cells, each group of four cells being designed to deal with 60 tons of refuse per day, and they have destroyed a total of nearly 190 tons on occasions.

THE HORNSBY OIL ENGINE.

The growing interest in oil engines makes it desirable to call attention to a description in a recent issue of "Engineering" of the new Hornsby 80-h.-p. three-cylinder vertical engine for direct connection to dynamos. The space occupied by the egine is 8 ft. x 5 ft. 9 in. x 6 ft. 6 in., and the weight is 7 tons, the engine developing 13 B.h.p. per ton when using refined oil. The speed is 400 r.p.m. The engines are enclosed. The cylinders are 12 in. x 12 in., made in one casting with large cleaning doors to the water spaces. The air and exhaust valves are in the top cover, which is also water jacketed. Forced lubrication is used for the main bearings, the connecting-rod ends and the cam-shaft skew gearing. The vaporier consists of a cast-iron bottle-shaped vessel, with the neck joined to the cylinder. The end is unjacketed and becomes hot by the heat of explosion. In this part the oil is injected. Any kind of oil or spirit can be used by proportioning the dimensions of the vaporier. A Hartnell type of governor is used, the speed being regulated by varying the stroke of the oil pumps, by moving the radius rods attached to the pump plungers up or down the curve of quadrant levers. Forced circulation is employed in connection with the cooling water arrangements. Details are given of three tests of one of the engines, with Scotch, Texan, and Russian oils. From these it appears that 0.79 lb. of Scotch gas, or shale oil, was used per B.h.-p.-hour, and 1.15 lb. of Texan fuel oil per kw.-hour. The degree of compression ranges from 84 lb. with Texan, and 106 lb. with Scotch, to 140 lb. per sq. in. with refined Russian oil.

TRADE PUBLICATIONS.

A little handbook of rules for the use of electric contractors has been published by the Rolfe Electric Co., Rochester, N. Y. It also gives very full direction for installing electric bells and buzers, fuse boxes and other supplies.

Water-tube boilers are described in a folder issued by the Henry Vogt Machine Co., Louisville, Ky. This type is a horizontal water-tube boiler built in two forms, one with longitudinal and the other with cross steam drums.

The J. S. Thorn Co., 1227 Callowhill St., Philadelphia, has published a 64-page book describing a large variety of sheet-metal window fittings, shutters, skylights, ventilators, doors and other fittings for fireproof buildings. It is generally acknowledged that window openings and doorways are among those features of buildings offering the greatest fire hazard, and on this account the book should interest property owners as well as architects.

Metropolitan injectors are illustrated in a new catalogue isued by the Hayden & Derby Mfg. Co., 85 Liberty St., New York. The Metropolitan automatic, "1898" type, and double-tube injectors, H-D ejectors and jet apparatus are described in detail with directions for operation.

A well-written explanation of the advantages of central station heating systems for detached houses, shops and office buildings has been written by W. H. Schott, 1218 Marquette Bldg., Chicago. It is not an engineering catalogue but is intended for non-technical readers interested in central station heating.

The National Electric Co., Milwaukee, Wis., has undertaken the serial publication of an electrical catechism, which will give information concerning the technical applications of direct and alternating current electricity, collected from the most recent literature and from practical experience.

A special lubrication for feeding graphite and oil in combination is decribed in a small pamphlet issued by the Comstock Engine Co., 49 Clymer St., Brooklyn. This lubricator, known as the "Comstock" operates upon a principle heretofore untried.

The new Bethlehem power pump, designed especially for economical operation in small municipal water works, etc., in connection with Corliss engine drives, is explained in a pamphlet issued by the Bethlehem Foundry & Machine Co., So. Bethlehem, Pa.

The MacDonald rivet forge is illustrated in a bulletin of the Ingersoll-Sergeant Drill Co., New York. In this forge the usual fan blower is retained, but the blower is here driven, turbine-like, by the air jet.

The Watertown automatic engine is referred to in a folder issued by the Watertown Steam Engine Co., Watertown, N. Y. Some of its advantages are explained and the range of sizes built at the works is outlined.

Rickard's Corliss steam engines are described in a catalogue of the Corliss Engine Works, 4041 N. Fifth St., Philadelphia, Pa. The advantages of the Ricard's modification of the Corliss valve gear are referred to in detail, and new features of the engine are pointed out.

The Johnson arch plate for facilitating the work of repairing and rebuilding furnace door arches is described in a folder issued by the Wellman-Seaver-Morgan Co., Cleveland, O. It consists of a special plate of cast steel to be hooked over the ram of the charging machine to permit of repairs being made to the arch.

The Thompson-Ryan dynamo is illustrated in its various forms in Bulletin 14 of the Ridgway Dynamo & Engine Co., Ridgway, Pa. The details of its construction are described, the special pole ring with its balancing coils for maintaining a fixed plane of commutation being particularly referred to.

Electrical heating apparatus for railway cars and domestic purposes is explained in a recent catalogue of the Gold Car Heating & Lighting Co., New York. The various types of heaters and allied apparatus are well illustrated.

Seamless rolled steel pipe manufacture is explained in an elaborate 10x14-in. pamphlet issued by the new Seamless Rolled Steel Pipe Co., Chester, Pa. The advantages of steel pipe for water and gas are discussed, and the new Bartlett-Kent rolling mill, specially designed for rolling the seamless pipe is described with illustrations.

The DeLaval centrifugal pumps are described with considerable detail in catalogue B of the DeLaval Steam Turbine Co., Trenton, N. J. The interesting feature of these pumps, the impeller or rotating member, is carefully described and its principle of operation explained. This is supplemented by several illustrations of the apparatus in different forms and the results of tests of them.

General Electric fan motors for 1905 are illustrated in the attractive catalogue 1048 of the General Electric Co., Schenectady. The descriptions and illustrations of the various types of fans have been prepared very carefully.

The interesting fact that 212 Curtis steam turbines are installed for commercial operation or under construction is revealed in a recent General Electric Co. publication. The total generating capacity represented by these turbines is nearly 875,000 kw. Another pamphlet issued by the General Electric Co., presents many illustrations, with descriptive matter, of the Curtis turbine as installed in power plants.

Bulletins 9 to 15 of the Browning Engineering Co., Cleveland, O., treat of their automatic grab buckets of the clamshell type for handling crushed limestone and granulated slag, and locomotive cranes for steam power plants, for use in the lumber industry and larger ones for handling loads of 15 and 20 tons at 10 ft. radius, etc. These cranes have many features which adapt them to severe service requirements.

Notes on induction integrating wattmeters and their use are given in pamphlet 5006, published by the Fort Wayne Electric Works, Fort Wayne, Ind. Bulletin 1060 is descriptive of the new types of portable wattmeter calibraters, in both the ringing and registering forms. Bulletin 1058 refers to the Fort Wayne multiphase revolving field engine-driven generators.

The De Laval steam turbines, turbo-generators and turbine-driven blowers and centrifugal pumps are illustrated in considerable detail in the second edition of catalogue A of the De Laval Steam Turbine Co., Trenton, N. J. The catalogue gives reports of tests of a 300 h.p. turbine. Speed diagrams are also presented of Corliss and other reciprocating engines under varying loads and also of a gas engine, in comparison with the De Laval turbine.

Roof ventilators and anti-friction bearing metals are discussed in a pamphlet issued by the Mechanical Metal Mfg. Co., 369 Bourse Bldg., Philadelphia, Pa. Several grades of bearing metals are made, including Mechanical bronze and babbitt metals. The Mechanical roof ventilator is made in both round and rectangular forms and with the skylight feature in the larger sizes.

The New York Blower Co., 25th Place and Stewart Ave., Chicago, has issued a circular on the Blackman type of propeller fans for operation by belt or direct-connected motor.

Gas engine ignition is discussed in a pamphlet from the Goodson Electric Ignition Co., Providence, R. I. The system employs a special magneto dynamo, direct-driven from the engine. The armature has a variable rotative motion, which is accelerated at time of spark, so that a full spark is obtained every cycle, no matter how slowly the engine is turning. This enables the engine to be started without batteries and also permits timing the spark very closely.

The Portland Wire & Iron Works, Portland, Ore., has issued a catalogue showing a large number of designs of ornamental iron and wire work for various purposes.

The reliability and economy of Louisville hydraulic cement are discussed in a pamphlet issued by the Western Cement Co., Louisville, Ky.

Considerable general information on reinforced concrete construction is given in a pamphlet issued by The Engineering Company of America, 74 Broadway, New York.

The catalogue of The Cyclone Drilling Machine Co., Orrville, O., on Cyclone contractors' drills illustrates the different types of this portable drill, which is adapted to sinking water, gas and oil wells, blast holes, prospecting holes for coal, etc.

The Detroit Graphite Mfg. Co., Detroit, Mich., has issued a folder on special colors for steel cars, containing a number of shades conforming to standard colors in use on various railway systems.

The Brady Cement Stone Machine Co., Jackson, Mich., has issued a catalogue on the concrete block making machines that it manufactures. These compress the concrete into blocks somewhat as clay is compressed in making ordinary building brick and are adjustable to make blocks of various sizes and shapes.

The New York Metal Ceiling Co., 527 West 24th St., New York, has issued a large catalogue showing the great variety of designs in which metallic ceilings are made and the various uses to which stamped sheet metal may be applied.

Steel wheelbarrows, charging barrows and wagons, ore and dump cars, and all kinds of trucks and steel wheels are shown in the illusrated catalogue of the Archer Iron Works, 34th Place and Western Ave., Chicago, Ill.

The American Hydraulic Stone Co., Century Bldg., Denver, Col., makes a machine for moulding concrete blocks for hollow walls and partition, the design, operation and capacity of which are quite fully described in a catalogue issued by the company.

Special types of the hydraulic turbines and a relief valve made by the Trump Mfg. Co., Springfield, O., are shown in an illustrated folder that the company is sending out.

A pamphlet on heavy duty steam shovels, which the Vulcan Iron Works Co., Toledo, O., is sending out, contains as much useful information in a few pages as is usually given in a large catalogue. Diagrammatic elevations and a plan on which the parts of a 70-ton steam shovel are numbered are shown, a key to the diagrams and brief descriptions of some of the parts accompanying the diagrams.

The advantages of electric hoists for contractors and industrial plants and brief descriptions of some of their parts form the subject of Bulletin 10 of the Maine Electric Co., Portland, Me.

Single and double expansion, lock-nutted and double parallel expansion bolts, wedge and square headed, ring and eye, and various other kinds of expansion bolts, are listed with accompanying tables of sizes and prices in the catalogue of the Steward & Romaine Mfg. Co., and the Philadelphia Expansion Bolt Co., Philadelphia, Pa.

The Shallow automatic water-level gauge is described in a recent folder from the William S. Haines Co., 136 South 4th St., Philadelphia. It is provided with valves in each boiler connection which will close automatically if the glass breaks, thus preventing escape of water and steam. Strong claims are made for the special construction in the valves, which is arranged to prevent clogging and stoppages which might cause the gauge to indicate falsely the water level in the boiler.

The importance of feed-water heating and purifying in general, and the advantages of the Webster system in particular, are explained in an interesting manner in a pamphlet forming part of the general catalogue of Warren Webster & Co., Camden, N. J. The new form of Webster combined open feed-water heater and chemical purifier is illustrated and views are given of several installations of this type.

The Vulcan shaking and dumping grates, boiler front castings and other castings for use in boiler settings, manufactured by the A. D. Granger Co., Pittsburg, Pa., are illustrated in its bulletin 4, recently issued. A very complete line of boiler setting and grate supplies is listed.

An extensive line of gate and globe valves and accessories for steam, water, gas, air, ammonia, etc., is illustrated in the new catalogue of the Nelson Valve Co., Wyndmoor, Pa. Valves are made in many different forms for all classes of services and a feature of the line is the Nelson hydrant.

The regulation of centrifugal fans and pumps is discussed in a pamphlet issued by the Aktieselskabet-Elling Compressor Co., Kristiania, Norway, who are owners of patents covering a new principle of governing. A drawback of the high-pressure centrifugal pump is the variation of pressure with varying delivery velocities, but this may be overcome, it is asserted, with the system described, which involves an interesting method of deflecting the vanes for regulation.

Safety feed-water regulators, high-pressure steam traps, steam pump governors and safety water columns, number among the steam specialties referred to in a recent catalogue of the Williams Gauge Co., 543 Fourth Ave., Pittsburg, Pa. The feed-water regulators and traps of this company operate on a positive principle which is well described. They are largely used by the steel mills in the vicinity of Pittsburg.

Traveling cranes, railway transfer tables, trolley hoists, locomotive cranes and other classes of hoisting machinery are interestingly treated in catalogue 20 of the Northern Engineering Works, Detroit, Mich. This company builds all classes of traveling cranes, for power or hand driving, the power systems involving either direct or alternating current motor equipments, as desired. A feature of the catalogue is the excellent illustrations of cranes installed.

Automatic injectors, jet pumps and the other steam specialties of the Pemberthy Injector Co., Detroit, Mich., are described in its new 1905 catalogue. Many classes of equipment are embraced besides injector apparatus, one of the most interesting being a new type of double automatic water gauge, consisting of double glasses, with automatic checks which is claimed to be better than a low-water alarm.

PERSONAL NOTES.

Capt. William V. Judson, Corps of Engineers, U. S. A., has been transferred to the Ninth Lighthouse District to relieve Major James G. Warren, Corps of Engineers, U. S. A.

Mr. John F. Stevens has been appointed chief engineer of the Isthmian Canal Commission to succeed Mr. John F. Wallace. Mr. Stevens will also be general manager of the Panama R. R.

Mr. Edwin W. Kramer assistant engineer for Mr. John V. Schaeffer, Jr., on the construction of Rockefeller Hall at Cornell University, has accepted a position as leveler on the New York State Barge Canal, with headquarters at the division office at Fairport, N. Y.

Col. Robert A. Marr, professor of engineering in Virginia Military Institute, has been offered the deanship of the engineering department of the Virginia Polytechnic Institute at Blacksburg, Va., to succeed the late Col. William M. Patton.

Brig.-Gen. Peter C. Haines and Major B. M. Harrod, of the Isthmian Canal Commission, have gone to the Isthmus to make a careful examination of the work as it now stands and collect data for the use of the advisory board of engineers which meets in September.

Mr. Fred Charles has been appointed city engineer of Richmond, Ind., to succeed Mr. H. L. Webber, who recently resigned to become chief engineer of the Ft. Wayne & Wabash Valley Traction Co., and of the Ft. Wayne, Bluffton & Marion Traction Co., with headquarters at Ft. Wayne, Ind.

Mr. H. T. Douglas, Jr., chief engineer of the West Side Belt R. R., Pittsburg, Pa., has resigned, and the engineering work on that road will be under the direct supervision of Mr. George T. Barnsley, chief engineer of the Wabash R. R., east of Toledo, O. Mr. Douglas will be retained as consulting engineer by the Wabash R. R.

Mr. W. T. Stadelman, Eastern agent of the Wellman-Seaver-Morgan Co., in charge of the Eastern office of that company in New York, has been appointed general sales agent with headquarters in Cleveland, Ohio. Mr. Fred Stadelman has been appointed assistant manager of the Eastern office. Mr. Harry V. Croll has accepted a position with the company.

The retirement of Col. William A. Jones, Corps of Engineers, U. S. A., has resulted in the following promotions in the Corps of Engineers, U. S. A.: Lieut.-Col. Henry M. Adams, to be colonel; Major William M. Black, to be lieutenant-colonel; Capt. E. W. Van C. Lucas, to be major; First Lieut. Lewis H. Rand, to be captain, and Second Lieut. Lewis M. Adams, to be first lieutenant.

Mr. A. B. Cuthbert, assistant engineer on the Northern Central Ry., has been appointed assistant engineer on Philadelphia division of the Pennsylvania R. R., succeeding Mr. J. K. Stewart, who has been temporarily relieved on account of ill-health. Mr. J. J. Rhodes has been made assistant engineer of the Eastern and Susquehanna divisions of the Northern Central Ry., succeeding Mr. E. B. Wiseman, who has been transferred to another division.

An office of administration of the Isthmian Canal Commission has been established in the Mills Building, Washington, for the conduct of the several affairs of the

Commission. Col. Clarence R. Edwards, U. S. A., will be chief of office, and the staff will include Mr. W. Leon Pepperman, assistant chief of office; Mr. Ernest S. Benson, general auditor; Mr. James G. Jester, disbursing officer, and one of the engineer members of the Commission.

BUSINESS NOTES.

The American Bridge Co. has removed its Seattle, Wash., office to 1306-1307 Alaska Bldg. H. W. Jack, contracting manager.

Wm. B. Scaife & Sons Co., Pittsburg, Pa., has been awarded contract for all structural steel work for the Post Falls, Idaho, power plant of the Washington Water Power Co., Spokane, Wash. There will be two buildings, one 174x83, 52 ft. high, and the other 80x32, 33 ft. high.

The Mead-Morrison Mfg. Co., Boston, has recently closed a contract for the Metropolitan Works of the Brooklyn Union Gas Co. for a coal-unloading plant, which will make five plants installed for this company; a very complete system for the unloading of coal from boats for the Queensboro Gas & Electric Co., consisting of an unloading rig and a shuttle cable road; just finished a comprehensive system for unloading coal, coke and sand from railroad cars and depositing in storage pockets, sheds and piles, for the Bridgeport, Conn., Malleable Iron Co., and furnished two powerful electric storage battery locomotives for handling the product through the yards and buildings; recently closed a contract for the Interborough Rapid Transit Co. for a coal and ash handling equipment, which includes an unloading tower of the latest type, and four McCaslin conveyors at their 59th St. and North River power station, and for building a very large unloading and storage system at Port Arthur for the Canadian Northern Dock Co., which will be one of the largest plants built in the Northwest.

The executive offices of the Church Construction Co., general builders, are now located in the Fuller Bldg., Broadway and Twenty-third St., New York City.

Mr. G. M. Gest, the subway contractor of New York and Cincinnati, has just been awarded a contract for the extension of the subway system of the Cumberland Telephone & Telegraph Co., of New Orleans, La. The extension will be a portion of the original system which the same firm installed several years ago.

The Green Fuel Economizer Co., Matteawan, New York, is now prepared to execute orders for steel-plate fans, blowers, exhausters, heaters and similar apparatus for all purposes. The company's new shop, which is equipped with the latest improved machine tools for economically producing high-grade work, is now completed and running. Standard designs and standard sizes of fans will be made, but the company is prepared to build fans for special conditions, and its experts will consider special requirements and prepare plans for fans most suited to the purpose. The company's wide experience with natural, induced and forced draft plants in connection with installations of Green economizers enables its engineers to make the best application of draft systems.

Mr. C. T. Wills, 156 Fifth Ave., New York, is executing in Greater New York building contracts aggregating about $10,000,000. They include a nearly completed 26-story office building on Wall St., with 3,500 tons of steel, a 4-story marble front bank building for Redmond & Co. on Pine St., a 6-story building for the American Can Co., on 14th St., the manual trade school building for St. George's Church, 16th St., the Tiffany & Co. 8-story store building, Fifth Ave., the Gorham building and extension, Fifth Ave., the Lady chapel extension to St. Patrick's Cathedral, the New Jersey Central terminal depot at West 22d St., St. Paul's Chapel and Hamilton Hall at Columbia University, a private library for Mr. J. P. Morgan and a number of new residences.

The National Fireproofing Co., of New York, has secured contracts for fireproof work in a number of new buildings in London. American methods of steel framing and fireproof construction are being adopted to a considerable extent by British architects and will be applied in a great number of office and warehouse buildings and in four large modern hotels that are under construction or contemplated in London. The company recently made a test in that city under the direction of the British Fire Prevention Committee of its patented reinforced terracotta arch construction. The arch that was tested consisted of hollow burned clay material, with a metal reinforcement in the form of a wire truss, the whole supported by I beams which sustain the superimposed load. This construction was subjected to a temperature of 1,700 deg. for 4 hours and water then applied to the underside of the arch, which are the test requirements of the British Fire Prevention Committee. The test was entirely successful and was satisfactory to the authorities, insuring more extensive adoption of this method of fireproof floor construction in London and all parts of England.

CONTRACTING NEWS

OF SPECIAL INTEREST TO CONTRACTORS, BUILDERS, ENGINEERS AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

**Vallejo, Cal.*—L. Kaarsburg, City Engr., writes that contracts were awarded on June 7 for water works extension, as follows: To Geo. H. Tay Co., of San Francisco, for 39,950 lin. ft. of c. i. pipe (Universal), of which 18,000 ft. is of 74 in. thickness and 21,950 of 65 in. thickness, 2,128 tons in all, and including 45 4-in. gate valves and 45 blow-off valves, for a total of $86,767, and to D. Fleming, of Vallejo for trenching hauling and laying pipe, etc., $9,750.

Coalinga, Cal.—H. H. Greva, of Coalinga, is reported to have made a location on the headwaters of the San Benito, and intends taking water into the Coalinga oil district by means of a tunnel through the mountains.

**Wilmington, Del.*—The following are reported to be the bids opened by the Bd. of Water Comrs., June 26, for the erection of an addition to the City Mills pumping station: A. J. Reed & Bro., Wilmington, $59,600 (awarded contract); John E. Healy, Wilmington, $68,072; Manufacturing Constr. Co., Wilmington, $58,006, and Miller Bros., Philadelphia, Pa., $59,900.

Kewanee, Ill.—Bids will be received until July 14 by the Water Com. (S. J. Sharp, Chmn.) for furnishing materials and sinking a deep well for this city. Chas. F. Sturtevant, Engr., 279 Dearborn St., Chicago.

**Mt. Olive, Ill.*—Theo. H. Koch, Pres. of Village, writes that Thos. J. Byrne, 3125 Sheridan Ave., St. Louis, Mo., has secured the contract for constructing water works (bids opened June 30) for $21,750.

Chicago, Ill.—Bids will be received until July 20 by the Dept. Pub. Wks. (Jos. M. Patterson, Comr.) for constructing a brick water tunnel about 145 ft. in length and a brick shaft about 61 ft. deep, adjacent to the 68th St. pumping station.

Georgetown, Ill.—The Council is reported to have under consideration the issue of bonds for water works.

Moline, Ill.—The Council is stated to have adopted an ordinance, providing for the laying of water mains, to cost $16,308.

East Moline, Ill.—The Kimball Eng. Co., of Davenport, Ia., has surveys under way for the construction of water works and a sewerage system for East Moline.

Flora, Ind.—Robt. Toole, Town Clk., writes that the South Bend Constr. Co., of South Bend, is engineer for the proposed water works; probable cost $10,000.

Columbus, Ind.—It is reported that plans are being prepared for the construction of a filtration plant, to cost about $20,000. Geo. Vorwald, City Clk.

Markle, Ind.—The Town Bd. is reported to have decided to construct water works.

Evansville, Ind.—Architects Harris & Shopbell, of Evansville, are reported to be preparing for the Water Wks. Bd. plans for rebuilding the river wall of the water works pumping station.

Ft. Wayne, Ind.—The Water Wks. Trus. are reported to have selected Dan'l W. Mead, First Natl. Bank Bldg., Chicago, Ill., to prepare plans for a reservoir, with a capacity of 9,000,000 gal.

Elkhart, Ind.—The Elkhart Water Co. is reported to have in contemplation improvements, to include a 6,000,000-gal. pump and an 18-in. main across the Lake Shore R. R. yards.

Atoka, Ind. Ter.—R. E. Koons, of Muskogee, is stated to have been selected to prepare plans for the construction of water works for Atoka.

Chetopa, Kan.—See "Power Plants, Gas and Electricity."

Greensboro, Md.—The question of constructing water works is reported under consideration here.

Falmouth, Mass.—At a recent town meeting $20,000 is reported to have been voted for extending the water system to East Falmouth.

Peabody, Mass.—Engr. F. A. Barbour, of the firm of Snow & Barbour, Boston, writes in regard to water works extension that bids for pipe laying will be received July 10 and for a concrete line tunnel about July 15. Bids for 15,000 ft. of 20 and 24-in. pipe were received July 3. H. F. Walker is reported to be Chmn. Water Supply Com.

North Andover, Mass.—The citizens are reported to have voted to issue $16,000 bonds for the extension of the water works.

**Belding, Mich.*—The U. S. Cast Iron Pipe & Fdy. Co., Chicago, Ill., has secured the contract for furnishing pipe and the American Light & Water Co., Kansas City, Mo., the contract for pipe laying (bids opened June 5); Engineers, the Riggs & Sherman Co., Toledo, O.

Clinton, Minn.—It is stated that bids will be received until July 11 by F. W. Watkins, Village Clk., for a 12-hp. gasoline pumping engine and pump head and 1 deep-well pumping head belt drive.

Utica, Miss.—J. B. Collins, Mayor, writes that the citizens voted June 26 to issue $10,000 bonds for the construction of water works. No engineer selected as yet.

Hazlehurst, Miss.—See "Power Plants, Gas and Electricity."

Savannah, Mo.—Burns & McDonnell, of Kansas City, are reported to be preparing plans for water works.

Keytesville, Mo.—Burns & McDonnell, 509 Dwight Bldg., Kansas City, are preparing plans for water works, to cost $11,500.

Jackson, Mo.—The citizens are reported to have voted to issue $27,000 bonds for water works.

**Liberty, Mo.*—R. I. Bruce, Clk., Bd. Pub. Wks., writes that contracts for constructing water works (bids opened June 22) have been awarded as follows: To American Light & Water Co., for furnishing and laying 9½ miles of 8, 6 and 4-in. pipe, including hydrants, valves, etc., $35,778; to Chicago Bridge & Iron Wks., Chicago, Ill., for tower and tank, $3,890, and to W. Kiersted for power and purification plant, $15,650.

Dillon, Mont.—Engr. Geo. R. Metler, of Dillon, writes in regard to the construction of a dam and reservoir on Redrock River, that the dam will cost $30,000 and rights $75,000. Preliminary surveys have been completed, showing an area of 41,500 acres covered to a depth of 5 ft. Before any construction is stated rights of way will have to be procured; storage capacity 410,000 acre ft.

Peterboro, N. H.—Bids will be received July 17 by the Water Com. (E. W. Jones, Clk.) for laying approximately 2½ miles 8 and 6-in. pipe, etc., as advertised in The Engineering Record.

Charleston, N. H.—Bids will probably be received about Aug. 1 by the Charleston Water & Sewerage Co. (Frank W. Hamlin, Pres.) for the construction of water Works and a sewerage system, to cost about $35,000. Engineer, Arthur W. Dudley, of Manchester.

Atlantic City, N. J.—The Bd. of Water Comrs. (Kennet Allen, Supt. and Engr.) and the Bd. of Trade are reported to have under consideration the installing of a reservoir system in this city, at a cost of $400,000; also the laying of a new main across the meadows, to cost about $100,000.

Elizabeth, N. J.—The question of establishing municipal water works here is reported under consideration. Bernard J. Higgins, Chmn. Special Com. of Council.

Roswell, N. M.—Fred. J. Beck, City Clk., writes that no franchise has yet been granted for water works, and the city may construct a municipal system, at a cost of about $60,000.

New York, N. Y.—Bids will be received until July 19 by John T. Oakley, Comr. Water Supply, Gas and Electricity, for furnishing material and changing the line of 36-in. water main under the N. Y. C. & H. R. R. R. at Southern Boule., near 142d St., Boro. Bronx; also same date for furnishing, delivering and laying water mains in 22 streets, Boro. Manhattan.

The following are the bids opened on July 5 by John T. Oakley, Comr. Dept. Water Supply, Gas and Electricity, for *a* 2,700 tons straight pipe, *b* 100 tons special castings (price given per ton): W. J. Drummond, 182 Bway., *a* $26.44, *b* $56; Warren Fdry. Mach. Co., 170 Bway., *a* $25.70, *b* $54; U. S. Cast Iron Pipe & Fdry. Co., 71 Bway., *a* $24,95, *b* $48; Camden Iron Wks., Camden, N. J., *a* $26.80, *b* $54.

Rochester, N. Y.—Bids are wanted July 19 for the construction of Cobbs' Hill reservoir, which will have a capacity of 140,000,000 gal., as advertised in The Engineering Record.

Albany, N. Y.—The new State Water Comn. was organized in Albany June 28. The question of increasing New York City's water supply was taken up and John A. Sleicher and Dr. Ernest Lederle were appointed a committee to confer with Mayor McClellan, of N. Y. City, on the subject.

Long Island City, L. I., N. Y.—Bids will be received until July 19 by John T. Oakley, Comr. Water Supply, Gas and Electricity, New York City, for furnishing and delivering c. i. water pipes, branch pipes and special castings in Boro. Queens.

Asheville, N. C.—The question of constructing a storage water reservoir is reported under consideration here.

Toledo, O.—The following are the bids opened by the Bd. of Pub. Service June 30 for improvement of the water supply (Edw. D. Bolton, of Toledo, Engr. of Filtration System):

Centrifugal pumps, gas engines and gas producers: Olds Gas Engine Works, Lansing, Mich., $55,072; Allis-Chalmers Co., Milwaukee, Wis., $60,700; S. M. Jones Co., Toledo (4 bids) $55,500, $49,000, $54,000 and $47,000.

Steam pumps and boilers: Kilby Mfg. Co., Cleveland, O., $94,790 (informal); Providence Eng. Wks., Providence, R. I., $75,000 (informal); Builders' Iron Fdy. Co., Providence, R. I., $62,000; Holly Mfg. Co., Buffalo, N. Y., $79,426; Snow Steam Pump Wks., Buffalo, N. Y., $57,780; Arbuckle, Ryan & Co., Toledo, $49,595 (informal); Allis-Chalmers Co., Milwaukee, Wis., $52,300, and Heisler Mfg. Co., St. Mary's, O., $53,073.

Extra producers or boilers (*a*) 125-h.p., (*b*) 175-h.p.: Kilby Mfg. Co., *a* $2,768, *b* $3,322; Providence Eng. Wks., *a* $3,500, *b* $4,500; Builders' Iron Fdy. Co., *a* $3,000; Olds Gas Eng. Wks., $2,900; Holly Mfg. Co., *a* $3,300; Snow Steam Pump Wks., *a* $3,300; Allis-Chalmers Co., *a* (2 bids) $6,500 and $2,120; S. M. Jones Co. (4 bids) $6,490, $5,170, $6,490 and $5,170, and Heisler Mfg. Co., *a* $3,190, *b* $3,932.

Perrysburg, O.—Bids will be received until Aug. 1 by T. M. Franey, Village Clk., for $30,000 bonds to be used for the construction of water works.

Cincinnati, O.—Bids will be received until July 28 by the Bd. Trus. Comrs. Water Wks. (Aug. Herman, Pres.) for manufacturing, furnishing and delivering sluice, gate and mud valves for the filtration plant and for the mains from the Western Pumping Station.

Bids will be received by the Bd. of Trus., Comrs. of Water Wks., Aug. 1 for laying c. i. pipe and special castings and valves on Eggleston Ave. and 9th St., as advertised in The Engineering Record.

Fredericktown, O.—Thos. Cureton, of Columbus, Consulting Engr. for the proposed water works at Fredericktown, writes that the probable cost is $20,000. No date set as yet for award of contract. John G. Davis, Pres. Bd. Pub. Service.

Condon, Ore.—A. W. Mohr, of The Dalles, is reported to have prepared plans for water works.

Philadelphia, Pa.—The Select Council on June 29 passed ordinances providing for the laying of water pipe in numerous streets.

Union City, Pa.—The citizens are reported to have voted to issue $20,000 bonds to rebuild the water supply pipes.

**Items marked thus give the names of parties awarded contracts.*

Columbia, S. C.—Specifications are on file at the office of The Engineering Record, 114 Liberty St., New York, N. Y., for the construction of water works (bids to be opened Aug. 8), as advertised in The Engineering Record. Engineer, J. L. Ludlow, Winston, N. C.

Belle Fourche, S. D.—It is reported that the Belle Fourche Power & Water Co. has plans for the construction of a 500,000-gal. reservoir.

Franklin, Tenn.—The Mayor and Bd. of Aldermen are in the market for about 1,600 tons c. i. pipe, 4 to 10 in., for the proposed water works. H. P. Fowlkes, Recorder. Engineers, Kirkpatrick & Johnson, Jackson, Miss. Other contracts will be let later on.

Longview, Tex.—Bonds to the amount of $25,500 have been sold, to be used for the construction of water works.

**Ft. Sam Houston, Tex.*—Capt. L. J. Fleming, Q. M., U. S. A., writes that the contract for constructing a sewer and water system here (bids opened June 14) has been awarded to Thos Franklin, of San Antonio, for $9,288.

Swanton, Vt.—M. W. Barney, Village Pres., writes that the question of a new water supply is under consideration, to connect with present pipe, but no definite action has yet been taken.

Norfolk, Va.—The question of establishing a central pumping station for the Fire Dept., is reported to be under consideration here.

Richmond, Va.—See "Power Plants, Gas and Electricity."

Leesburg, Va.—The City Recorder writes that it is proposed to hold a new election, to vote on issuing bonds for water works.

Walla Walla, Wash.—The City Council is stated to have appointed a committee to procure a right of way along Mill Creek for a gravity system of water works.

Blaine, Wash.—H. L. Jenkins is reported to have purchased the water works, and will install a heavy-pressure salt water system for fire service.

Puyallup, Wash.—Robt. Wilson, City Clk., writes that the citizens voted June 29 to construct a gravity system of water works. Engineers, Dunne, Coale & Dunne, of Seattle.

Winnipeg, Man.—Bids will be received by the chairman Fire, Water and Light Com., Aug. 7, for furnishing gas engine pumping plant, as advertised in The Engineering Record.

Huntley, Mont.—The following are the bids opened June 28 at the office of U. S. Reclamation Service, Billings, Mont., for the construction of pumping station, concrete culverts, siphons, etc., along line of canal east from Huntley (Robert S. Stockton, Project Engr., Huntley): (*a*) W. D. Lovell, Minneapolis, Minn.; (*b*) Deadwood Constr. Co., Deadwood, S. D.; (*c*) Chas. Spear, Billings, Mont.; (*d*) Cotton Bros. Co., Oakland, Cal.:

	a	*b*	*c*	*b*
10,000 cu. yd. excav., Class I	$0.65	$0.30	$1.00	$0.55
500 cu. yd. excav., Class II	1.00	0.40	0.65	0.90
500 cu. yd. excav., Class III	2.00	0.90	1.25	1.30
1,000 cu. yd. overhaul, per 100 ft.	0.025	0.02	0.05	0.02
500 cu. yd. puddle	0.50	0.50	0.60	0.75
1,000 cu. yd. riprap	3.50	6.00	4.50	2.50
200 cu. yd. rubble wall	3.50	4.50	5.40	4.00
100 cu. yd. coarse gravel	1.00	0.75	0.80	1.00
400 cu. yd. concrete, Class I	3.73	6.40	5.70	10.00
1,200 cu. yd. concrete, Class II	3.98	7.50	9.50	10.50
40-ft. span steel bridge	596.00	850.00	1,400.00	900.00
60-ft. span steel bridge	986.00	1,300.00	1,800.00	1,200.00
6,000 lbs. gates and guides	0.06	0.06	0.08	0.12
4 stands with shaft, complete	150.00	100.00	150.00	100.00
120,000 lb. steel for concrete re-enforcement	0.0288	0.035	0.035	0.04
1,500 lin. ft. tile drain pipe, 8 in.	0.45	0.50	0.40	1.00
50 lin. ft. c. i. pipe, 8 in.	1.50	1.50	1.50	2.00
150 flashboards	2.75	1.00	1.00	0.30
Pumping Station—				
Item A, building by-pass and auxiliary structure, complete	7,750.00	7,500.00	11,000.00	17,200.00
Item B, change in lengths of by-pass, if brick, lin. ft.	25.00	12.55	28.00	30.00
Item C, same as A, but with concrete by-pass, complete	7,450.00	7,200.00	10,800.00	16,700.00
Item D, change in length of by-pass, if concrete, lin. ft.	20.00	6.85	25.00	25.00
Total—				
With Item "A"	$33,813.50	$38,115.00	$51,110.00	$54,085.00
With Item "C"	$33,513.50	$37,815.00	$50,910.00	$53,585.00

Huntley, Mont.—The following are the bids opened June 28 at the office of the U. S. Reclamation Service, Billings, Mont., for the construction of about 30 miles of canal, Huntley project (Robt. S. Stockton, Project Engr., Huntley): (*a*) Nick Hughes, Butte; (*b*) Griffiths & McDermott, Chicago, Ill.; (*c*) Challahan, Katz, Phelan & Shirley, Omaha, Neb.; (*d*) W. D. Lovell, Minneapolis, Minn.; (*e*) Cotton Bros. & Co., Oakland, Cal.; (*f*) Chas. Spear, Billings. (*g*) Jas. Forrestal Co., St. Paul, Minn.:

Division 1—	*a*	*b*	*c*	*d*	*e*	*f*	*g*
Dry excav., Class I, 35,000 cu. yd.	$0.17	$0.17	$0.17	$0.21	$0.23	$0.50	..
Dry excav., Class II, 14,000 cu. yd.	.50	.33	.40	.74	.60	.60	..
Dry excav., Class III, 29,000 cu. yd.	.97	.85	1.15	.99	1.05	.90	..
Wet excav., Class I, 20,000 cu. yd.	.50	.25	.40	.63	.27	.75	..
Wet excav., Classes I and II, 1,000 cu. yd.	1.50	1.00	1.40	1.50	2.50	1.10	..
Overhaul, 1,000 cu. yd., per 100 ft.	.10	.015	.02	.02	.02	.025	..
Tunnel Type I, 900 lin. ft.	12.00	33.00	35.85	39.00	29.00	39.00	..
Tunnel Type II, 315 lin. ft.	13.00	39.00	45.85	42.00	31.00	42.00	..
Tunnel Type III, 300 lin. ft.	15.50	45.00	49.85	49.00	33.00	43.00	..
Concrete, Class I, 2,200 cu. yd.	3.50	6.25	8.00	3.73	7.00	6.00	..
Concrete Class II, 100 cu. yd.	6.00	6.75	9.00	4.00	8.00	7.00	..
Setting gates, 40,000 lb.	.025	.015	.02	.015	.03	.02	..
Riprap, 100 cu. yds.	4.00	1.25	2.00	3.50	2.75	3.00	..
Rubble wall, 100 cu. yds	5.00	2.25	2.50	3.50	3.00	3.00	..
Total Div. 1	†$82,425	$112,095	$135,733	$133,476	†$118,560	†$144,655	..
Division 2—							
Excav., Class 1, 305,000 cu. yds.	$0.15	1.15	.15	1.39	..	..	.17
Excav., Class II, 100 cu. yds.	.60	.30	.30	.80	..	..	1.00
Excav., Class III, 100 cu. yds.	1.50	.75	.80	1.20	..	..	2.00
Overhaul, 20,000 cu. yds., per 100 ft.	.10	.015	.02	.015	..	..	.015
Riprap, 100 cu. yds.	5.00	1.50	2.00	3.50	..	..	4.00
Total Div. 2	‡$48,460	$35,630	$46,460	$43,245	......	......	$52,850
Division 3—							
Excav, Class I, 350,000 cu. yds.	$0.15	.12	.15	1.69	..	..	.17
Excav., Class II, 100 cu. yds.	.60	.40	.30	.85	..	..	1.00
Excav., Class III, 100 cu. yds.	1.50	.80	.80	1.00	..	..	2.00
Overhaul, 20,000 cu. yds., per 100 ft.	.10	.015	.02	.02	..	..	.015
Riprap, 100 cu. yds.	5.00	1.50	2.00	4.00	..	..	4.00
Total Div. 3	§$55,210	$42,570	$53,210	$60,135	......	......	$60,500
Grand Total	$186,095	$190,295	$235,403	$236,856	......	......	......

†For whole of Division 1, or nothing.
‡For whole of Division.
§Lowest bid for Division.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Fresno, Cal.—W. H. Ryan, City Clk., writes that the city is asking for plans for a system of sewage disposal; as soon as plans are accepted an election will be called to vote on the question of issuing bonds for same.

San Francisco, Cal.—The Bd. of Pub. Wks. has informed the Superv. that it will cost about $46,830 to extend streets, grade, fill in and sewer Bryan, York and Hampshire Sts., from 26th St. to Army St.

**Bridgeport, Conn.*—Patk. Kennelly, Dir. Pub. Wks., writes that the contract for constructing about 1,000 ft. 48-in. brick sewer (bids opened July 1) has been awarded to Abbott D. Canfield, of Bridgeport, at $7.95 per ft.

New Britain, Conn.—Bids will be received by the Sewer Comrs. on July 17 for building sewers, manholes and appurtenances for 4 sections of the city, as advertised in The Engineering Record.

Washington, D. C.—Bids will be received by the Bldg. Com., U. S. Dept. of Agriculture (B. F. Galloway, Chmn.) on Aug. 1 for the construction of a sewer for the new buildings, as advertised in The Engineering Record.

Washington, D. C.—See "Miscellaneous."

Bids will be received by the Comrs. D. C., July 24, for constructing a portion of sewage disposal system 4½ St. High Level intercepting sewer, as advertised in The Engineering Record.

*The Dist. Comrs. are reported to have awarded contracts for the fiscal year 1906 as follows: For terra-cotta pipe and "Y" branches, to M. J. Drummond & Co.; for vitrified invert block, to the Mack Mfg. Co.; for repressed invert sewer brick, to A. B. McPorter; for all red sewer brick, to the Standard Brick Co., and 200,000 clay brick, to the Federal Clay Product Co.

Quitman, Ga.—The following are the bids opened June 28 by the Mayor and Bd. of Aldermen for the construction of a sewerage system (Engineer, H. S. Jaudon, Quitman): A. L. Patterson & Co., Macon, $22,529 (awarded contract); Geo. O. Fenny, Spartanburg, S. C., $24,604; Bryan & Co., Jacksonville, Fla., $27,603. Beeman & Co., Louisville, Ky., $26,377, and West Constr. Co., Chattanooga, Tenn., $26,204.

Tampa, Fla.—Bids will be received on July 25 by the Bd. of Pub. Wks. for furnishing material and constructing about 17 miles of sanitary sewers, of vitrified salt-glazed terra-cotta pipe and appurtenances, as advertised in The Engineering Record.

Moline, Ill.—The City Council has adopted the ordinance providing for the construction of the 5th Ward sewer, to cost $19,536.

East Moline, Ill.—See "Water."

Riverside, Ind.—The question of constructing a sewerage system of tile is reported under consideration.

Angola, Ind.—The Town Bd. is reportetd to be considering the construction of a sewerage system.

Bloomington, Ind.—Ulysses S. Hanna, City Engr., writes that preliminary surveys have just begun for a separate system of sewers; pipe will probably be used.

West Lafayette, Ind.—It is stated that bids will be received until July 17 by the Bd. Trus. for constructing sewer north of State St. and the Brown St. levee. Chas. T. Stallard, Town Clk.

Bartlesville, Ind. Ter.—City Engr. Wm. H. Whaley is reported to be preparing plans and estimates for the extension of the sewerage system.

Sioux City, Ia.—The Council is reported to be preparing to establish a sewerage system in Crescent Park.

Ossawatomie, Kan.—Burns & McDonald, 509 Dwight Bldg., Kansas City, Mo., have been selected to prepare plans for a sewerage system.

Muskegon, Mich.—This city is preparing to construct the Spring St. sewerage system, about 12 miles in length, to cost about $40,000. Will probably not build all of it this year. Clifford S. Gamble, City Engr.

Monroe, Mich.—Harry J. Sterner, City Clk., writes that the citizens will be asked to vote on the construction of sewers, to cost between $60,000 and $70,000. J. W. White, Engr.

Brainerd, Minn.—Bids will be received until July 17 by F. E. Low, City Clk., for constructing 275 ft. 12 and 10-in. lateral sewer.

Two Harbors, Minn.—The Village Council is reported to have authorized the Committee on Sewers to have an estimate of cost prepared for constructing a main sewer in East Two Harbors.

St. Paul, Minn.—The City Engr. is reported to have estimated the cost of the Fairview Ave. sewerage system at $25,600.

Fairmont, Minn.—Prof. A. Marston, of the Iowa Agricultural College, Ames, Ia., is reported to be preparing plans for a sewerage system for Fairmont.

**Meridian, Miss.*—The Southern Paving & Constr. Co., of Chattanooga, Tenn., is reported to have on June 23 secured the contract for sewer work for $4,980.

Corinth, Miss.—Bids are wanted July 17 for furnishing material and constructing a system of house sewers, about 7 miles in length, 6 to 15-in. diam., as advertised in The Engineering Record.

St. Charles, Mo.—Burns & McDonnell, 509 Dwight Bldg., Kansas City, have been selected to prepare plans and specifications for a sewerage system; Carr Edwards, City Engr.

Ferguson, Mo.—L. L. Atwood, Mayor, writes that the probable cost of sewerage work proposed is $25,000. The $8,000 bond issue recently voted will include cost of septic tanks. No engineer selected as yet.

Anaconda, Mont.—N. Knudson, City Engr., writes that bids will be received about Aug. 1 for the construction of a sewer in the Eastern addition, to cost about $10,000.

**University Place, Neb.*—Chas. G. Sheely, of Lincoln, is reported to have secured the contract for the construction of a sewerage system for $13,800.

Charleston, N. H.—See "Water."

**Kearny, N. J.*—Wm. Green is stated to have secured the contract for constructing a 24-in. pipe sewer in Tappan St. (bids opened June 28) for $4,963.

Newark, N. J.—Edw. S. Rankin, Ch. Engr., Dept. of Sewers, is reported to be preparing plans for a sewerage system in the section west of Elizabeth Ave. and south of Hawthorne Ave.

Contracts for constructing sewers (bids opened June 22) have been awarded as follows: 1st Division, to the McGovern Constr. Co., Trenton, for $32,188 (concrete sewer), and the 2d Div. to Jas. A. Christie, Newark, for $30,747 (concrete sewer). For bids received for this work, see issue of The Engineering Record July 1. Edw. S. Rankin, Ch. Engr. St. and Water Bd.

New York, N. Y.—Bids will be received until July 12 by Louis F. Haffen, Pres. Boro. Bronx, for constructing sewers and appurtenances in portions of Walton Ave. and Ave. St. John, Kelly St., and Brown Pl. Engineer's estimate: 3,096 lin. ft. 12 and 15-in. pipe sewer; 40 lin. ft. 12-in. drain pipe, furnished and laid; 33 manholes; 4,025 cu. yds. rock to be excavated and removed, etc. Also for completing abandoned contracts for constructing sewers and appurtenances in portions of Marmion St., and repairing surface drains in Van Nest. Engineer's estimate: 2,250 cu. yds. dry rubble, to be converted into rubble masonry in mortar, as specified and shown on plan; 438 cu. yds. concrete, including steel bars, as specified and shown on plan; 560 cu. yds. rock to be excav. and removed; 508 lin. ft. 12 and 15-in. pipe sewer; 6 manholes, complete; 44 manhole frames, heads and covers, complete; 36 lin. ft. 12-in. drain pipe, furnished and laid, etc., all in Boro. Bronx.

Brobklyn, N. Y.—Bids will be received until July 19 by Martin W. Littleton, Pres. Boro. Brooklyn, for furnishing materials and constructing sewers in portions of 20th and 61st Sts. Engineer's estimate: 2,085 lin. ft. 24, 18, 15 and 12-in. sewer pipe; 18 manholes; 10 sewer basins; 191 cu. yds. concrete cradle, etc.

**Bronxville, N. Y.*—Contracts for sewer works (bids opened June 16) have been awarded as follows: To De Nallo & Klingberg, of Kingston, for a low-level sewer, $4,518; to Bellew & Merritt, Tuckahoe, for high-level sewer, $19,454; to Reis & O'Donovan, of New York, for pumping machinery, $1,590, and to Abbott & Gamble Co., of New York, for pump, well and house, $1,600. T. W. Tooker, Engr. in charge.

Lebanon, O.—Bids are wanted July 18 for furnishing material and constructing about 3,060 lin. ft. of trunk sewer, as advertised in The Engineering Record.

Youngstown, O.—Bids will be received until July 15 by the Bd. Pub. Service (Geo. T. Prosser, Clk.) for constructing a sewer in a portion of Walnut St.

**Items marked thus give the names of parties awarded contracts.*

Ravenna, O.—The following are the detail bids opened on June 24 for constructing about 17 miles of sewers and the totals for a sewage disposal plant (Engr., W. E. Myers, Kenton, O.): (1) total of sewers; (2) disposal plant: (*a*) W. C. Fishburn, Pittsburg, Pa., (1) $66,573, (2) $33,065; (b) J. M. Davidson, Akron, (1) $76,887; (c) Chas. C. Heutis, Buffalo, N. Y., (1) $92,723, (2) $39,912; (*d*) Piero & T urnbull, Canton, (1) $97,908; (*e*) King-Lambert Constr. Co., Des Moines, Ia., (1) $102,480 (*f*) Ed. McShoffney & Son, Akron, (1) $78,111; (*g*) Vetter & Merriam, Youngstown, (1) $86,844, (2) $33,733; (*h*) S. W. Parshall, Akron, (1) $ 63,435; (*i*) Geo. McNally, Pittsburg, Pa., (1) $92,350, (2) $38,859; (*j*) W. J. Irwin, Greenville, (1) $80,949; (*k*) John M. Healey, Chicago, Ill., (1) $105,278; (*l*) John O'Neil, Akron, (1) $57,743; (*m*) Clemmaro Bros. Constr. Co., Cleveland, (1) $83,836, (2) $40,921. (*n*) W. J. Townsend Co., Cleveland, (1) $63,437, (2) $39,868; (*o*) International Constr. Co., Pittsburg, Pa., (1) $69,247, (2) $40,131; (*p*) Bowman Bros., McKeesport, Pa., (1) $112,155, (2) $53,324; (*q*) Beers & Doolittle, (1) $78,859, (2) $41,763; (*r*) M. Applegate, Columbiana, (1) $67,609; (*s*) Phillips & Bixel, (1) $77,456.

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*	*o*	*p*	*q*	*r*	*s*
Pipe Sewers, including Y branches—																			
9,634 lin. ft., 15-in.	$0.46	$0.42	$0.52	$0.45	$0.67	$0.40	$0.48	$0.37	$0.58	$0.50	$2.50	$0.35	$0.53	$0.40	$0.41	$0.55	$0.39	$0.59	$0.50
1,934 lin. ft., 12-in.	.35	.32	.39	.33	.47⅕	.29	.35	.27	.45	.40	1.40	.26	.38	.32	.32	.33	.30	.40	.34
2,025 lin. ft., 10-in.	.25	.25	.29	.26	.33	.23	.27	.20	.37	.30	1.20	19½	.29	.20	.25	.25	.24	.31	.27
82,555 lin. ft., 8-in.	.15	.18	.20	.19½	.24	.14½	.20	.14	.29	.22	.75	.13	.20	.16	.19	.16	.15	.22	.17
Excavation—			.26	.40	.46	.20	.17	.15	.20	.20	..	16	.20	.30	.26	.40	.26	.13	.20
5,720 lin. ft. excav., 0—6-ft. cut.	.19	.12																	
45,879 lin. ft. excav., 6—8-ft. cut.	.25	.20	.40	.48	.54	.32	.25	.25	.30	.28	..	.23	.31	.30	.30	.45	.29	.22	.22½
29,020 lin. ft. excav., 8—10-ft. cut.	.34	.31	.60	.65	.66	.39	.40	.25	.43	.40	..	.28	.44	.30	.38	.60	.37	.31	.40
4,976 lin. ft. excav., 10—12-ft. cut.	.47	.45	.80	.80	.74	.55	.65	.55	.57½	.55	..	.38	.64	.38	.42	.75	.67	.46	.55
4,301 lin. ft. excav., 12—14-ft. cut.	.67	.75	.89	.90	.90	.80	.93	.65	.74½	.65	..	.50	.90	.48	.48	1.00	.87	.59	.80
570 lin. ft. excav., 14—16-ft. cut.	.88	1.00	1.20	1.30	.98	1.45	1.40	2.00	.95½	.80	..	1.00	1.12	.65	.54	1.50	1.19	.77	1.40
1,900 lin. ft. excav., 16—18-ft. cut.	1.08	1.75	1.52	1.65½	1.30	1.75	1.97	2.00	1.29	1.50	..	1.00	1.45	.80	.58	2.00	1.67	.99	1.90
206 lin. ft. excav., 18—20-ft. cut.	1.34	3.00	1.92	1.69½	1.45	3.40	3.23	3.00	1.60	1.90	..	2.00	2.00	1.08	.66	3.50	2.30	1.32	2.50
3,710 lin. ft. 20 ft. and over	1.84	5.00	2.61	2.25	1.80	3.50	3.90	2.50	2.07	2.30	..	2.50	2.50	1.65	.70	6.00	3.60	1.60	3.00
113 manholes, each	33.00	22.70	35.00	41.00	36.00	35.00	35.00	25.00	57.50	45.00	45.00	25.00	32.00	30.00	40.00	50.00	27.00	27.00	37.00
67 lamp holes, each	3.00	3.00	5.00	5.00	9.00	3.50	3.00	2.00	5.75	7.00	6.00	1.00	3.00	6.00	2.00	12.00	7.00	5.10	3.00
65 flush tanks, each	45.00	60.00	50.00	35.00	48.00	30.00	45.00	25.00	50.00	50.00	50.00	22.00	65.00	28.00	50.00	70.00	40.00	32.00	45.00
25.5 tons iron pipe, laid per ton	30.00	35.00	40.00	40.00	42.00	34.00	175.00	26.00	48.00	60.00	40.00	40.00	45.00	35.00	38.00	40.00	30.00	40.00	34.00
200 cu. yds concrete	6.00	5.00	5.50	10.00	8.00	4.25	8.00	6.00	7.50	8.00	7.00	4.00	5.00	5.00	7.00	10.00	6.70	6.00	5.00
Shoring and sheathing left in trench, per M.	20.00	35.00	35.00	25.00	35.00	35.00	25.00	20.00	28.00	30.00	50.00	30.00	20.00	18.00	22.00	50.00	17.00	25.00	25.00
4,807 cu. yd. excav. opened ditch per cu. yd.	.50	.18	.30	50	...	.25	.100	.20	.80	.26	.60	.16	.50	.35	.75	.50	.60	.30	.60

**Scotia, N. Y.*—The following are reported to be the bids opened June 22 for furnishing and laying pipe for the first section of the new sewer system: De Nallo & Klingberg, Kingston, N. Y., $12,317 (awarded contract); Kellam & Shafer, $12,454; J. H. Clements, $13,332; C. R. Lewis, $14,398; Irwin & Koaster, $16,423; T. R. Crane, $14,105; Sam'l Bonn, $18,683; Beckwith Bros., $14,190; Golden & Hall, $15,877; Mr. Gridley, $13,539; Frank Besch, $17,023; Vosburg & Van Ness, $17,353; Hinman & Sprohl, $13,417; Schenectady Contr. Co., $17,421, and De Graffe & De Graffe, $17,170.

Dayton, O.—Bids will be received until July 22 by Edwd. Phillips, City Aud., for $15,000 bonds for constructing storm water sewers.

Bellaire, O.—Bids will be received until July 13 by the Bd. Pub. Service (F. A. Jackson, Clk.) for furnishing materials and constructing a sewer in a portion of Walnut Alley.

Toledo, O.—Bids will be received until July 13 by the Bd. Public Service (Harry S. Jones, Secy.) for furnishing material and constructing a pipe sewer in a portion of Bush St.

London, O.—Bonds to the amount of $56,000 are reported sold, to be used for sewerage and a sewage-disposal plant.

Cincinnati, O.—Bids will be received until July 12 by the Bd. Pub. Service, for furnishing material and improving a portion of Burnet Ave., by constructing sewers and drains.

Bids will be received until July 13 by the Bd. Pub. Service, Geo. F. Holmes, Clk., for furnishing materials and constructing sewers in a portion of Elberon Ave.

Elyria, O.—It is reported that plans have been completed for the construction of new sewers.

Carbondale, Pa.—All bids opened by Council on June 26 for laying about 1½ miles of lateral sewers, are stated to have been rejected and new bids will be received.

**Pittsburg, Pa.*—The contract for reconstructing the Garfield Alley brick sewer is stated to have been awarded on June 28 to the International Constr. Co., Bessemer Bldg., for $14,400.

Altoona, Pa.—It is stated that bids are wanted by the Bd. Pub. Wks. (And. Kipple, Chmn.) for constructing vitr. clay pipe sewers.

Temple, Tex.—The City Council is reported to have granted P. L. Downs and F. L. Denison a franchise for a sewerage system.

**Galveston, Tex.*—The following are reported to be the bids opened on June 26 by the Bd. of City Comrs. for the 33d St. sewer extension: F. O. Brown, $24,802; Galveston Gasfitting & Plumbing Co., $15,140; J. C. Kelso, $15,296, and E. G. Truehart, $14,793 (awarded contract).

Bids will be received until July 13 at the office of John D. Kelley, City Secy., for constructing vitr. pipe sewers and appurtenances in portions of 13th St. and an alley. C. G. Wells, City Engr.

Ft. Sam Houston, Tex.—See "Water."

Beloit, Wis.—It is stated that bids will be received until July 19 by the Bd. Pub. Wks. for constructing storm water and sanitary sewers in various streets. R. R. Cald-

Sheridan Wyo.—Bids are wanted July 20 for the purchase of bonds, to provide funds to establish, construct, purchase, extend, maintain and regulate a system of sewerage. The citizens recently voted $38,000 for this purpose. E. W. Long, Town Clk.

BRIDGES.

Notes Arranged Alphabetically by States.

Fresno, Cal.—Scott McKay, Co. Surveyor, writes that bids will be received about July 17 for the construction of a steel bridge over San Joaquin River at Pollasky, to cost about $30,000.

Hartford, Conn.—Bids will be received by the Bd. of St. Comrs. July 19 for constructing the sub-structure of highway bridge over the tracks of the Central New England Ry. at Albany Ave.; also same date for superstructure, both advertised in The Engineering Record.

Oglethorpe, Ga.—Bids are wanted between July 10 and 20 for approximately 9,000 yd. of concrete arches, piers and abutments between Montezuma, Ga., and the Chattahooche River, about 8 miles west of La Grange; also same date for approximately 2,500,000 ft. B. M. trestling, to be built between Paschal, Ga., and Chattahooche River. For further information address Alex. Bonnyman, Engr., Oglethorpe, Ga.

**Des Moines, Ia.*—O. P. Herrick is stated to have received the contract for filling the approaches of the 6th Ave. bridge for $14,817.

Ellicott City, Md.—See "Railroads."

Dowagiac, Mich.—Highway Com. Smith, of Silver Creek, is reported to be drawing specifications to receive bids for a new steel bridge, to replace the one which gave way under a traction engine on the Indian Lake Road recently. The new bridge will be 40-ft.

Litchfield, Minn.—Bids will be received until July 20 by the Bd. Co. Comrs. for constructing 2 steel bridges, one over the North Fork of Crow River, in Forest City Township, and the other over South Fork of Crow River, in Cedar Mills Township; also a 12 ft. span stone arch or concrete bridge over Collinwood Creek in Sec. 13, Township 119, Range 29; J. N. Gaynor, Co. Aud.

Trenton, N. J.—Bids will be received until July 11 by the Bd. Chosen Freeholders (D. L. Cook, Dir.) for furnishing materials and constructing a combination steel and concrete bridge over Bear Brook, in W. Windsor Township; also same date for laying a 48-in. iron-pipe culvert and building end retaining walls, crossing Groveville Road in Hamilton Township. Frank J. Eppele, Co. Engr.

New York, N. Y.—The Bd. of Estimate on June 30 granted an appropriation of $10,000 for preliminary surveys for the Hudson Memorial Bridge at Spuyten Duyvil.

Geo. E. Best, Bridge Comr., and O. F. Nichols, Ch. Engr. Dept. of Bridges, presented to Bd. of Estimate on June 30 new plans for the construction of a $5,000,000 terminal at the Manhattan end of the Brooklyn Bridge, which will double its present capacity.

Binghamton, N. Y.—Bids will be received until July 17 by D. C. Herrick, City Clk., for constructing a bridge over Chamberlain Creek on Robinson St.

Weldon, N. C.—T. Cranmer Harrison, Town Attorney, writes that the Bd. of Aldermen on July 1 voted to employ an engineer to prepare plans and specifications for a steel bridge across Roanoke River.

Fargo, N. D.—It is stated that bids will be received until July 15 by the Bd. Co. Comrs. for constructing and repairing a number of bridges throughout the county. Arthur G. Lewis, Co. Aud.

Eaton, O.—It is stated that a bridge 300 ft. long will be constructed over Big Twin Creek, Jackson Tp. and Lanier Tp. Probable cost, $15,000.

Zanesville, O.—The County Comrs. are stated to have received from Walter Braun, of Columbus, recently appointed to examine the 5th St. Bridge, his report, in which he submits two separate estimates of cost; the first contemplates cleaning and painting the entire superstructure, constructing a new floor system and paving on the roadway, except that portion of the bridge west of river and having a brick pavt., which he estimates at $53,938. The second contemplates cleaning and painting and constructing a new floor and roadway on the entire superstructure at an estimated cost of $61,070.

Lancaster, Pa.—See "Electric Railways."

Lebanon, Pa.—It is stated that an iron bridge will be constructed over Swatara Creek, at a cost of about $30,000.

Spokane, Wash.—Three contracts calling for the expenditure in Spokane County of about $300,000 are stated to have been signed on June 22 by the Spokane & Inland Ry. Co., the Spokane Terminal Co. and the Spokane & Cœur d'Alene Electric Road, Porter Bros. having received the contract for the construction of 7 bridges in Spokane and along the line of the Spokane & Inland R. R. Two of the bridges are to span the Spokane River just south from the present Olive Avenue bridge; one is to span Rock Creek about 7 miles from Spokane, another will cross California Creek, 12 miles southeast of here, another about 2 miles farther up the creek, one will span Rock Creek 22 miles from Spokane and the last will be across Latah Creek about 30 miles from the city, near Waverly.

Charlestown, W. Va.—Plans and bids will be received on July 20 for the erection of a truss bridge across Elk River, connecting Charleston and Lovell Sts., as advertised in The Engineering Record.

Eau Claire, Wis.—Bridge bonds amounting to $35,000 are reported sold.

Menominee, Wis.—Bids will be received until July 15 by F. W. Rowe, City Clk., for constructing the sub-structure of a bridge over Red Cedar River, as advertised in The Engineering Record. Bids will be received same date for constructing 2 combined stone and brick arch bridges over Gallaway Creek, 1 on 3d St. and 1 on 5th St.

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

**Birmingham, Ala.*—20th, 19th and S. 20th Sts., 5th and Highland Aves. will be paved with bitulithic. Contracts aggregating 98,457 sq. yds. have been awarded the Southern Bitulithic Co.

Montgomery, Ala.—Bids will be received until July 17 by R. S. Williams, City Trus., for paving sidewalks on portions of 8 streets with Schillinger or hexagon block.

Watertown, Conn.—It is reported that bids are wanted until July 18 for paving with brick portions of Grand, W. Main and N. Willow Sts. R. A. Cairns, City Engr.

Hartford, Conn.—Bids will be received by the Bd. of Street Comrs. July 19 for grading about 1,800 lin. ft. new highway on Albany Ave., as advertised in The Engineering Record.

Ft. De Soto, Fla.—Bids will be received until July 27 by R. S. Pratt, Constr. Q. M., U. S. A., for constructing brick road and concrete sidewalks.

Tampa, Fla.—Bids will be received by the Bd. of Pub. Wks. July 25 for paving with vitrified brick and granite curb about 16 miles of streets, as advertised in The Engineering Record.

Galena, Ill.—The following bids are stated to have been received for paving Main St., *a* price per sq. yd., *b* intakes: Street, Steich & Lenehan, of Dubuque, *a* $1.35, *b* $35; A. E. Rutledge, of Rockford, *a* $1.29 with Purington brick or $1.31 with Purington block, *b* $20; Rink & Schnell, of Dixon, *a* $1.34, *b* $22, and M. Ford, of Cedar Rapids, *a* $1.45, *b* $19.

Peoria, Ill.—The construction of a boulevard 96 ft. in width, extending from Prospect Heights Ave. at Glen Oak Park to the main highway is reported under consideration.

East St. Louis, Ill.—Bids will be received by the Bd. of Local Improv., July 18, for paving several streets with brick; also paving one street with bituminous macadam.

**Belleville, Ill.*—L. L. Harper, City Engr., writes that the contract for paving with vitrified brick Illinois St. (bids opened June 24) has been awarded to Reeb Bros., of Belleville, for $18,219.

Rock Island, Ill.—Bids are wanted July 11 for paving 15th St. with asphalt; estimated cost, $12,016; W. Treichler, City Engr.

Bloomfield, Ind.—Bonds amounting to $64,132 are reported sold for constructing gravel roads in Greene County.

Mt. Vernon, Ind.—It is stated that bids will be received by the Common Council until July 17 for paving Walnut and Mulberry Sts. with asphalt and laying artificial stone curb and gutters. Henry Kling, City Clk.

Sioux City, Ia. — Bids will be received by the City Council until July 11 for paving with asphaltum about 3,700 yards on Jones and 5th Sts. W. J. Radcliffe, Chmn. Paving Com.

Creston, Ia.—It is stated that bids will be received until July 21 by A. W. Schimpff, City Clk., for paving with brick 9 blocks. J. C. Sullivan, Mayor.

Des Moines, Ia.—Bids will be received until July 22 by the Bd. Pub. Wks. (W. W. Wise, Chmn.) for paving about 832 sq. ft. of Clark St. with vitr. repressed brick; also constructing about 12,280 lin. ft. Portland cement curb on Kingman Boule. (or Ave.).

**Paducah, Ky.*—A contract for 40,000 sq. yds. bitulithic paving has been awarded to the Southern Bitulithic Co.

Louisville, Ky.—It is stated that the Bd. of Pub. Wks. will soon receive bids for paving with vitrified blocks Ormsby Ave., Floyd St. and Cane Run Road.

New Orleans, La.—Bids will be received until July 29 by Mordecai T. Endicott, Ch. Bureau Yards and Docks, Navy Dept., Washington, D. C., for grading and filling at the Naval Station, New Orleans; funds available, $35,000.

**Taunton, Mass.*—The City Council has awarded to the Warren Bros. Co., of Boston, the contract for 12,000 sq. yds. of bitulithic.

**Attleboro, Mass.*—J. M. McCarthy, Clk. Massachusetts Highway Comn., writes that the contract for constructing about 7,300 ft. of State highway in Attleboro (bids opened June 22) has been awarded to Lane Quarry Co., of Hingham, for $5,227.

Lansing, Mich.—H. A. Collar, City Engr., has been ordered to prepare plans for paving Ottawa St. with brick; length, ¾ of a mile.

Cedar Springs, Mich.—The citizens are stated to have voted to issue $5,000 bonds for street improvements.

Items marked thus give the names of parties awarded contracts.

Crookston, Minn.—J. E. Carroll, City Engr., has been authorized to prepare specifications for the paving of E. Robert St. with bitulithic or tar macadam, about 2,500 sq. yd.

**Meridian, Miss.*—The Southern Paving & Constr. Co., of Chattanooga, Tenn., is stated to have received the contract for paving with vitrified brick here for $46,859.

**New Brunswick, N. J.*—Contracts for constructing roads, bids opened June 28 by the Bd. of Chosen Freeholders at New Brunswick (Asbury Fountain Dir.) have been awarded as follows: Road No. 1, to C. M. Liddle, Woodbridge, $14,294; Road No. 2, Butcher & Le Compte, Freehold, $6,413; Road No. 3, Butcher & Le Compte, $8,443, and Road No. 4, Rue & Fountain, Old Bridge, $10,740.

Jersey City, N. J.—Bids will be received until July 17 by the Bd. Chosen Freeholders (John P. Egan, Clk.) for reconstructing and improving a portion of Paterson Plank Road.

New York, N. Y.—Bids will be received until July 12 by Louis F. Haffen, Pres. Boro. Bronx, for regulating, grading, curbing, flagging, paving and repaving portions of numerous streets. Engineer's estimate: 27,185 sq. yds. completed asphalt block pavt. and keeping the same in repair for 5 yrs. from day of acceptance; 12,975 sq. yds. granite block pavt., on a concrete foundation, laid wth paving cement joints; 49,735 lin. ft. new curb., furnished and set; 175,605 sq. ft. new flag, furnished and laid; 12,631 sq. ft. new bridgestone for crosswalks furnished and laid; 44,500 cu. yds. rock excav.; 47,870 yds. earth excav.; 161,690 cu. yds. fill; 4,470 cu. yds. dry rubble masonry, in retaining walls, culverts and gutters; 2,850 cu. yds. concrete, including mortar bed, etc.; also same date for constructing the Webster Ave. approaches to proposed bridge over the N. Y. & Harlem River R. R. and the Bronx River at E. 222d St. Engineer's estimate: 100 lin. ft. new curb., furnished and set; 1,500 lin. old curb. rejointed and reset; 180 sq. ft. new flag, furnished and laid; 6,100 sq. ft. old flag, rejointed and relaid; 16,100 cu. yds. fill; 100 lin. ft. 12-in. vitr. stoneware pipe; 150 lin. ft. 12-in. c. i. pipe, etc., all in Boro. Bronx.

The following are the bids opened June 30 by John F. Ahearn, Pres. Manhattan Boro., for regulating and repaving with wood block on concrete foundation, *a* Chambers St., *b* Vesey St., *c* Barclay St.: U. S. Wood Preserving Co., *a* $31,117, *b* $22,774, *c* $24,733 (lowest bidder); Eppinger & Russell, *a* $31,383 (lowest bidder), *b* $23,349, *c* $26,119; Franklin Contr. Co., *a* $32,070, *b* $22,144 (lowest bidder), *c* $26,701; Republic Contr. Co., *a* $32,459, *b* $24,154, *c* $27,030.

The following are the bids opened June 30 by John F. Ahearn, Pres. Manhattan Boro., for regulating and repaving with asphalt on present pavement relaid on foundation, *a* 67th St. from Ave. A to 3d Ave., *b* 117th St. from 5th to Pleasant Ave., *c* 83d St. from East End to Lexington Ave., *d* 25th St. from 1st to 4th Ave., *e* Houston St. from Norfolk to Sheriff St.: Asphalt Constr. Co., Madison Ave. and 137th St., *a* $9,518, *b* $18,312, *c* $15,735; Barber Asphalt Paving Co., 114 Liberty St., *a* $11,281, *b* $19,524, *c* $18,086, *d* $12,583, *e* $21,749; Continental Asphalt Paving Co., 32 Bway, *a* $14,569, *d* $14,989; Sicilian Asphalt Paving Co., 41 Park Row, *a* $10,597, *b* $20,720, *c* $17,254, *d* $12,207, *e* $16,425; Uvalde Asphalt Paving Co., 1 Bway, *a* $9,957, *b* $19,599, *c* $17,068, *d* $12,261, *e* $17,452; Century Constr. Co., 7 E. 42d St., *b* $23,509, *c* $19,557.

Brooklyn, N. Y.—Bids will be received until July 19 by Martin W. Littleton, Boro. Pres., for regulating, grading, curbing, paving and laying sidewalks in portions of numerous streets. Engineer's estimate: 60,680 sq. yd. asphalt, 29,225 sq. ft. cement sidewalks, 61,112 sq. ft. cement concrete sidewalks; 10,720 lin. ft. new curb, to be set in concrete; 8,420 cu. yd. concrete, 44,513 cu. yd. earth excav., etc.

Oneonta, N. Y.—Bids will be received by O. A. Miller, Village Engr., July 18, for furnishing the village with vitrified paving brick or block, Portland cement, crushed stone, sand and curb, as advertised in The Engineering Record.

**Buffalo, N. Y.*—The German Rock Asphalt Co., D. S. Morgan Bldg., is stated to have received the contract for repaving Eagle St., for $6,314.

*The contract for repaving a portion of W. Parade Ave. is stated to have been awarded to Barber Asphalt Paving Co., 880 Ellicott Sq., for $4,955.

**Rochester, N. Y.*—The contract for paving Melville St. with asphalt is stated to have been awarded to the Rochester Vulcanite Paving Co. of Rochester for $6,841.

Wilmington, N. C.—It is stated that bids will be received until July 25 by A. M. Waddell, Mayor, for furnishing from 10,000 to 20,000 tons of crushed stone for making streets in this city.

Niles, O.—Bids will be received until July 17 by the Bd. Comrs., Trumbull Co., Road Dist. No. 2 (A. G. McCorkle, Secy.) for furnishing material and improving roads in said road dist.

Youngstown, O.—Bids will be received until July 15 by the Bd. Pub. Service (Geo. T. Prosser, Clk.) for paving a portion of Ellenwood Ave.

Cincinnati, O.—Bids will be received until July 27 by the Bd. Pub. Service (Geo. F. Holmes, Clk.) for grading, curbing and paving a portion of 2d St. with granite blocks.

Bellaire, O.—Bids will be received until July 13 by the Bd. Pub. Service (F. A. Jackson, Clk.), for furnishing materials, grading and paving a portion of Washington St.

Mansfield, O.—Bids will be received until July 29 by D. S. Koontz, City Aud., for $25,000 Mulberry St. improvement bonds.

**East Liverpool, O.*—The contract to pave with brick on gravel foundation, Calcutta Road, from corporate limits to township line of St. Clair, 9,543 sq. yds. pavement, 10,736 lin. ft. broken stone, lateral support, and 2,100 ft. 6-in. sewer, was on June 22 awarded by the Trus. of Liverpool Township to Rinehart Bros., of East Liverpool, for $20,709. Rosser & Maloney, of Bellaire, bid for this work $20,904, and John M. Ryan, of East Liverpool, $21,049.

**Canton, O.*—F. E. Myers, City Engr., writes that the following are the lowest bids opened June 19 for paving 3 streets with vitrified block: C. & Wm. Turnbull, Canton, for E. 4th St., 10,340 sq. yd. pav't., $1.18½, and 3,965 lin. ft. curb, 40 cts.; total, $14,116. F. A. Pierre, Canton, for E. 3d St., 5,460 sq. yd. pav't, $1.18, and 2,306 lin. ft. curb, 44 cts.; total, $7,595 and Carl, Downs & Campbell, Canton, for Mahoning St., 21,280 sq. yd. pav't $1.18, and 5,915 lin, ft. curb, 45 cts.. total, $28,596.

**Dayton, O.*—The Barber Asphalt Paving Co. has secured the contract for repairing asphalt paving, 8,000 sq. yds (bids opened June 28) at $1.14½ per sq. yd., and for concrete foundation, 100 sq. yd., 40 cts. per sq. yd.; total $9,200. The other bidders were Kirchner Constr. Co., $9,761, and the Springfield Paving Co., $10,870.

Bids will be received until July 22 by Edwd. Philipps, City Aud., for $20,000 bonds for repairing and improving a portion of W. 5th St.

Ashland, O.—Bids are wanted July 11 for paving with brick, asphalt block or sheet asphalt Pleasant St. and Cleveland Ave., about 14,000 sq. yds., and 8,900 lin. ft. curb, as advertised in The Engineering Record.

Piqua, O.—It is proposed to pave Wayne St., from Sycamore St. to Wood St., at an estimated cost of $4,930. H. E. Whitlock, City Engr.

**Delaware, O.*—The contract for paving Sandusky and Winter Sts. (bids opened June 22) has been awarded to J. F. Gantz, of Bowling Green. The work will consist of about 18,000 sq. yds. Metropolitan block, Portland cement foundation and Berea curb.

It is stated that bids will be received by the Bd. Co. Comrs. until July 17 for grading, draining and macadamizing Rowlands Road, about 1½ miles. E. S. Mendenhall, Engr.

**Portsmouth, O.*—Jas. A. Kelly & Bro., of Portsmouth, have secured the contract for paving 6th St. (bids opened June 28) at the following bid: 9,512 sq. yds. vitr. brick, gravel base, 98 cts.; 4.478 lin. ft. cement curb and gutter, 35 cts.; 3 manholes, ea., $22, and 15 catch basin, ea., $20; total, $11,731. The other bidders were Jardino, Brewer & Tomlinson, of Chillicothe, for $13,148 and Saml. Monroe & Sons, $11,794. The contract for paving Lincoln St. with brick, 3,417 sq. yds. has been awarded to Saml. Monroe & Sons, of Portsmouth, at $1.17 per sq. yd. for vitr. brick on concrete base, tar filler, total cost, $5,031.

Brooklyn Heights, O.—H. H. Richardson, Village Clk., writes that it was voted June 19 to issue $7,000 bonds for paving.

Cincinnati, O.—Bids will be received until July 12 by the Bd. Pub. Service, Geo. F. Holmes, Clk., for furnishing materials and improving a portion of Conroy Alley, by grading, curbing and paving with brick; also July 26 with bitulithic, a portion of Hapsburg St.; also macadamizing a portion of Enright Ave.

It is stated that all bids received for paving Ringgold Pike, McAllister and several other streets with bitulithic paving have been rejected, being in excess of the $2.60 limit.

Port Clinton, O.—Bids will be received by W. H. Cleaver, Village Clk., until July 20, for furnishing materials and paving with either vitr. blocks, brick, asphalt blocks or sheet asphalt, portions of Madison and Fulton sts.

Panama.—Bids will be received until July 6 by the Isthmian Canal Comn., Washington, D. C., for furnishing 4,000,000 paving brick; also Aug. 5 for furnishing pitch, oil and asphaltum.

McKees Rocks, Pa.—Bids will be received until July 18 at the office of the Boro. Clk., 825 Mary St., for laying brick and cement sidewalk on Island and Chartiers Aves. S. L. Gardner, Boro. Engr.

New York N. Y.—The following are the bids opened June 30 by John F. Ahearn, Pres. Manhattan Boro., for regulating and repaving with asphalt on present pavement relaid as foundation 42d St., from Park to 7th Ave.: (*a*) Continental Asphalt Paving Co., 32 Bway; (*b*) Sicilian Asphalt Paving Co., 54th St. and 12th Ave.; (*c*) Uvalde Asphalt Paving Co., 1 Bway:

	a	*b*	*c*
11,830 sq. yds. asphalt pav'nt, including binder course	$3.25	$1.70	$1.90
11,830 sq. yds. old stone pavement, relaid as foundation, etc.	.40	.40	.40
3,300 lin. ft. new bluestone curb	.85	.80	.85
300 lin. ft. old curbstone, redressed	.28	.30	.30
27 noiseless covers, complete, for manholes	15.00	15.00	15.00
Totals	$46,473	$27,978	$30,509

New York, N. Y.—The following are the bids opened by John F. Ahearn, Pres. Manhattan Boro., June 30, for regulating and repaving with wood block on concrete foundation: (1) East Bway, from Chatham Sq. to Grand St.; (2) Duane St., from Bway to West St.; (3) Reade St., from Centre St. to West St.; (4) Greenwich St., from Battery Pl. to Dey St.: (*a*) U. S. Wood Preserving Co., 29 Bway, (1) $79,700 (lowest bidder), (2) $31,601 (lowest bidder), (3) $39,181, (4) $39,201 (lowest bidder); Eppinger & Russell Co., (1) $82,431, (2) $32,605, (3) $40,204, (4) $39,915. Franklin Constr. Co., 1 Hudson St., (1) $86,128, (2) $33,287, (3) $37,216 (lowest bidder), (4) $41,276. Republic Constr. Co., (1) $87,173, (2) $33,680, (3) $41,591, (4) $41,276. The detail bids received on East Bway, from Chatham Sq. to Grand St., are as follows:

	a	*b*	*c*	*d*
18,540 sq. yds. wood block pavement	$2.60	$2.75	$2.88	$2.95
18,540 sq. yds. old stone blocks, to be purchased by contractor and removed	.20	.23	.20	.22
3,090 cu. yds. concrete, including mortar bed	6.40	6.25	6.75	6.50
7,450 lin. ft. new curb, furnished and set	.94	.92	.96	.98
200 lin. ft. old curb, furnished and set	.32	.35	.35	.35
63 noiseless covers, complete, for manholes	15.00	15.00	15.00	15.00

Philadelphia, Pa.—The Common Council on June 29 passed ordinances providing for the macadmizing or surfacing of numerous streets.

**Pottstown, Pa.*—W. S. Royer, Town Clk., writes that the contract for paving King St., about 12,000 sq. yds., with brick (bids opened June 27) has been awarded to Willauer & Co., of Pottstown, at $1.23 per sq. yd. for paving and 12½ cts. per lin. ft. for curb.

Allentown, Pa.—Mayor Yost is stated to have approved the ordinance providing for the paving of Liberty and Madison Sts.

Wilkesbarre, Pa.—It is stated that bids are being received for paving Market St across the Kingston flats, probable cost of the improvement is $47,000.

Providence, R. I.—Peter J. Lannon, Clk. State Bd. Pub. Roads, writes that contracts for road work (bids opened June 28) have been awrded as follows: To Chas. A. Johnson, of Pontiac, R. I., for 5,280 ft. trap rock road in Warwick for $3,910 and to Luke H. Callan, of Bristol, for 2,640 ft. of road in Portsmouth, for $2,727.

Danville, Va.—The citizens are stated to have voted to issue $50,000 bonds for street improvements.

**Tacoma, Wash.*—The contract for paving about 42,000 yds. on Tacoma, Division Aves. and S. 1st. St. with asphalt is stated to have been awarded to Barber Asphalt Paving Co., of Seattle, for about $88,000.

**Seattle, Wash.*—The following are the bids opened June 24 by the Bd. of Pub. Wks. for laying concrete walks on Boston and other streets (bidders all of Seattle): David Dow & Co., $13,159; N. A. Johnson, $13,373; Hans Pederson, $13,830; Paul Wagoner, $13,445; Sparger Concrete Co., 602 Colman Blk., $13,142 (awarded contract). The detail bid of the successful bidder is as follows: Fixed estimate, $750; 3 M. ft. curb, $4; 24 M. ft. crosswalks, $10; 11,350 sq. yd. concrete walks, $1, and 440 sq. yd. alley crossings (concrete), $1.20.

Bids will be received by C. B. Bagley, Secy. Bd. Pub. Wks., on July 15, for paving Connecticut St. with vitrified brick, to include 2,736 sq. yds. paving, 8,500 cu. yds. earth work, 688 lin, ft. granite curb, etc.; estimated cost, $16,400; also same date for grading 38th Ave., N and other streets, at a cost of $6,500.

*The Sparger Concrete Co. has secured the contract for the construction of concrete walks on Boston and other streets, for $13,142.

The Bd. of Pub. Wks., on July 1st, recommended to City Council the improvement of 4th Ave. and other streets by grading and re-grading, at an estimated cost of $140,000.

Wheeling, W. Va.—Bids will be received until July 15 by the Bd. Co. Comrs. (T. C. Moffatt, Clk.) for laying about 2,000 sq. yd. brick paving at Highland Park on the National Road; also for excavating about 1,200 cu. yd. on the new road from foot of Shannon's Hill, on Short Creek, to the Reilly-Delaplaine Road. Herman L. Arbenz, Co. Engr., 1505 Chapline St.

**Ft. D. A. Russell, Wyo.*—Capt. W. S. Scott, Q. M., U. S. A., Cheyenne, writes that the contract for laying 14,000 sq, ft. sidewalks at Ft. D. A. Russell (bids opened June 15) has been awarded to R. W. Bradley and R. N. La Fontaine of Cheyenne,, at 20 cts. per sq. ft.

POWER PLANTS, GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

**San Francisco, Cal.*—The Bd. of Superv. is stated to have passed a resolution on recommendation of the Finance and Public Library Committees, awarding to the San Francisco Gas & Electric Co. the contract for supplying the city with gas, electric light and power during the year, for $320,000.

The Sierra Nevada Water & Power Co. has been incorporated with a capital of $5,000,000, by G. B. Crittenden, W. L. Stowell, R. M. Kreiser and others.

Eureka, Cal.—It is stated that bids are wanted until July 17 for the purchase of an electric power franchise. J. S. Brown, Chmn. of Com.

Santa Monica, Cal.—The City Trus. are stated to have decided to appoint a committee to investigate and report on the question of municipal ownership of the gas and electric light plants.

Santa Barbara, Cal.—The stockholders of the Merchants' Electric Co. are reported to have decided to proceed at once with the construction of an independent plant.

Chino, Cal.—The Chino Land & Water Co. is reported to have decided to construct an electric light plant for Chino.

Grand Junction, Colo.—A company is reported organized here, with W. F. White, Pres., to construct and operate a gas plant.

Wilmington, Del.—Mayor Chas. Bird has approved the ordinance recently passed by the Bd. of Dirs. of the Street and Sewer Dept., granting a franchise to the Wilmington Light, Heat & Power Co.

The questionn of constructing a municipal electric lighting plant in conjunction with the pumping station for street and public lighting only is under discussion here. Engineer, Theo. A. Leisen, Ch. Engr. Water Dept.

Calhoun, Ga.—Geo. C. Chambers is stated to have applied for a franchise for an electric light plant.

Ottawa, Ill.—The Ottawa Power Co. is reported incorporated with a capital of $5,000 to furnish heat, light and power. Incorporators: Jas. A. Seddon, Chas. W. Hadley and others.

Chicago, Ill.—Plans have been filed by the Commonwealth Electric Co. for a 2-story power house to be constructed at 22d and Fisk Sts., to cost $50,000; also for a 1 and 2-story brick power house, to cost $35,000.

Indianapolis, Ind.—The Bd. of Pub. Wks. is stated to have adopted plans and specifications for a fuel gas plant, and bids for the franchise will be received by the Board on Aug. 2.

**Ft. Wayne, Ind.*—The Western Gas Constr. Co. and the Kerr-Murray Mfg. Co. are reported to have secured contracts for the construction of an artifical gas plant for the Ft. Wayne Gas Co.; total cost $200,000.

Washington, Ia.—The Iowa Gas & Electric Co. is reported incorporated with a capital of $100,000.

Items marked thus give the names of parties awarded contracts.

Ames, Ia.—E. G. Pratt and H. E. Morton, Pres. and Mgr. respectively of the Boone Gas Co., are reported to have petitioned City Council for a franchise for a gas plant.

Newton, Ia.—It is reported that the Council will purchase a storage battery equipment for the electric light plant, at a cost of $8,000.

Grinnell, Ia.—John R. Howie and associates, of Brooklyn, Ia., representing the Northern Gas Constr. Co., are reported to have decided to petition Council for a franchise for a gas plant.

Atlantic, Ia.—The Atlantic Gas & Fuel Co. is reported to have taken charge of the Atlantic gas works and will make some improvements. E. J. Young, Secy.

Chetopa, Kan.—Burns & McDonnell, Dwight Bldg., Kansas City, Mo., are preparing plans and specifications for water works and an electric light plant, to cost about $30,000.

Ann Arbor, Mich.—The stock of the Washtenaw Light & Power Co. is reported to have been purchased by Alex. Dow, of Detroit, R. W. Hemphill, Sr., of Ypsilanti, and others. The directors are reported to have decided to develop the Huron River power, manufacture gas and extend the power service in Ann Arbor and Ypsilanti.

Hazlehurst, Miss.—The Town Council is reported to be considering the question of issuing $10,000 bonds to procure an additional water supply and improve the electric light plant.

Kansas City, Mo.—Bids will be received until July 21 by Jas. Knox Taylor, Superv. Archt., Washington, D. C., for installing a conduit and electric wiring system in the U. S. Post Office and court house here; bids will also be received on July 27 for the extension and changes incidental thereto of the low-pressure and exhaust steam heating, mechanical ventilating apparatus, ash hoist, etc., for said building.

Webb City, Mo.—J. C. Harrison and Robt. Holt, of Carthage, are reported to have petitioned for a franchise and contract to light Webb City.

Livingston, Mont.—John L. Bright is stated to have purchased the plant of the Livingston Water Power Co., and will expend about $60,000 in improvements.

Tecumseh, Neb.—An election will probably soon be held to vote on issuing $9,500 bonds for a new electric light plant. P. H. Hopkins, Mayor.

Hastings, Neb.—Bids will be received until July 14 by the Secy., Treas. Dept., Washington, D. C., for manufacturing and placing in position in the U. S. Post Office here certain combination gas and electric light fixtures.

Goldfield, Nev.—J. M. Beck and A. B. Vesper, of Pasadena, Cal., are reported interested in the construction of a gas plant at Goldfield.

New York, N. Y.—The Special Comn., consisting of Cary T. Hutchinson, Nelson P. Lewis, and Geo. F. Sever, on June 30 presented to the Bd. of Estimate plans for the proposed municipal electric lighting plant, to light the boroughs of Manhattan and the Bronx. Accompanying the plans were drawings of the proposed structure at East River, Ave. A and 90th Sts., as a central station. Including land, buildings and all equipment for a central station of a capacity of 15,000 kw. and a distributing system, designed to supply 15,000 arc lamps and 300,000 16-c.p. incandescent lamps, the cost of the plant

Buffalo, N. Y.—Bids will be received until July 12 by the Dept. Pub. Wks. (Francis G. Ward, Comr.) for installing, delivering and furnishing power to drive an electrically driven centrifugal pump at the Pumping Station, Bureau of Water, for a period of 1, 3 or 5 years, commencing from installation of said pump, on or about Dec. 1, 1905.

Fayetteville, N. C.—It is stated that bids are wanted until July 20 for additional improvements to municipal electric light plant; probable cost, $15,000. W. Thomas Jones, Supt.

Albemarle, N. C.—R. Smith, Secy. Albemarle Light & Water Co, writes that the company is in the market for an outfit for a small electric light plant.

Galion, O.—The Crawford Gas & Electric Co., recently organized here, is reported to be preparing to construct a power house here, at a cost of $75,000.

Bellevue, O.—The Mutual Light & Water Co. is stated to have secured a franchise to light the streets by electricity. The company is about to be incorporated, with a capital of $50,000. Incorporators: E. C. Crocker, B. F. Bell, Peter Brady, and others.

**Columbus, O.*—The Einer, Hopkins Co. is reported to have secured the contract for installing boilers, piping, engine generator and switchboard at the Institution for Feeble-Minded Youth, for $17,297.

Toledo, O.—The City Council is reported to have authorized Frank Consaul, City Engr., to prepare estimates for an electric light plant.

Kenton, O.—The Westinghouse Electric & Mfg. Co., Pittsburg, Pa., is reported to be preparing plans and estimates for improvements and extensions to the plant of the Kenton Gas & Electric Co., recently purchased by Kerlin Bros., of Columbus. It is stated that about $50,000 will be expended.

Philadelphia, Pa.—The following are the bids opened on July 1 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for the work complete for underground, lead-incased, braid-covered incandescent lighting and power cables for the Navy Yard, League Island: National Conduit Cable Co., 41 Park Row, New York, N. Y., $24,586; John A. Roebling's Sons Co., 612 S. Broad St., Trenton, N. J., $22,662; Standard Underground Cable Co., Westinghouse Bldg., Pittsburg, $22,965, and American Steel & Wire Co., Battery Park Bldg., New York, N. Y., $24,716.

**Lansdale, Pa.*—The Erie City Iron Co., of Erie, is reported to have secured the contract for the steam equipment for the municipal electric light plant for $9,400, and the Ft. Wayne Electric Co., Ft. Wayne, Ind., for the electric apparatus for $9,400.

**Ft. Mansfield, R. I.*—Capt. E. F. Ladd, Q. M., U. S. A., New London, Conn, writes that contracts for an electric lighting system at Ft Mansfield (bids opened June 15) have been awarded as follows: To J. F. Buchanan, of Philadelphia, Pa., for wiring and fixtures; Malcolm W. Hill Co., Baltimore, Md., for service lines, and Westerly Gas & Electric Co., of Westerly, for the current.

Central Falls, R. I.—Wm. H. Goldsmith, Clk. Com. on Municipal Electric Light Plant, writes that the matter of constructing an electric light plant is to be decided in joint special convention; probable cost of plant $75,000.

Richmond, Va.—The Water Com. has adopted the report of the sub-committee endorsing the proposed new electric light plant at the old pump house, to cost for building $12,000; electric pumps, motors, transformers, switch-board, transmission line, etc., $25,000, and for a main between pump house and new reservoir, $52,000.

Bristol, Vt.—The Lake Dunmore Power & Traction Co., which recently absorbed the Bristol Electric Co., is reported to be constructing a steam auxiliary plant and has completed surveys for a large dam, to be built about a mile above its present plant on New Haven River. Engineer, H. W. McIntosh, of Burlington.

Tacoma, Wash.—The Fire and Water Committee has recommended the passage of a resolution authorizing the City Clerk to call for bids to be submitted by Oct. 1 for the construction of a water power generating plant of not less than 5,000-h.p. and not more than 10,000-h.p.

Wausau, Wis.—Bids will be received until July 14 by the Secy., Treas. Dept., Washington, D. C., for manufacturing and placing in position in the U. S. Post Office here certain combination gas and electric light fixtures.

**Rossland, B. C.*—S. A. Campbell, Engr., Rossland, writes in regard to the development of Upper Bonnington Falls that Ross & Holgate, of Montreal, Que., are the hydraulic engineers in charge and he is supervising the electric installation. The contracts for apparatus have been awarded as follows: To I. P. Morris Co., of Philadelphia, Pa., for water wheels; to Canadian General Electric Co., of Toronto, Ont., for generator and switchboard apparatus, and to the Westinghouse Electric & Mfg. Co., of Pittsburg, Pa., for the transformers.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

Los Angeles, Cal.—The right of way committee arranging the proposed extension of the Los Angeles Interurban Ry. Co.'s line from North Glendale to Burbank, a distance of 4½ miles, has made sufficient progress to warrant putting a survey corps in the field.

Taylorville, Ill.—The United States Construction Co. is reported incorporated to construct an electric railroad from Decatur, via Taylorville, Mechanicsburg, Springfield, Petersburg, Mt. Sterling, to Quincy. Incorporators: Geo. M. Skelley, John E. Melick, James S. Sutton, Chas. F. Bisch and Cyrus Farrow. The right of way from Springfield to Petersburg has already been secured, and it is said that construction work will begin at once.

Jerseyville, Ill.—The Carlinville, Alton & St. Louis Ry. Co. is reported incorporated. The line is to be reconstructed from Carlinville to Jerseyville and to Alton through the counties of Macoupin, Jersey and Madison to the east bank of the Mississippi River; capital, $2,000. Incorporators: Andrew W. Cross, Jos. M. Page and others of Jerseyville, and Robt. Cuddie, of Alton, Ill.

Laporte, Ind.—The South Bend, Western Ry. Co. and the Laporte & Michigan City Traction Co., capitalized at $500,000 and $400,000 respectively, have been merged into the South Bend, Laporte & Michigan City Traction Co., with a capital of $1,000,000. The South Bend Western Co. is now building an interurban line between Laporte and South Bend. The intention is to extend the line northwest to Chicago and east to Cleveland, O.

Indianapolis, Ind.—The North Central Ry. Co. has been incorporated with a capital of $500,000 to build a traction line from Wanetah, through Valparaiso, Hobart, Tileston, Hammond and Whiting, in Porter and Lake counties. Directors: John Conkey, of Valparaiso; C. H. Jones and E. L. Gower, of Indianapolis.

Greensburg, Ind.—A franchise has been granted to Chas. L. Henry, Pres. of the Indianapolis & Cincinnati Traction Co., for an entrance into the city of the proposed extension from Shelbyville to Greensburg.

North Manchester, Ind.—The City Council is stated to have granted a franchise to the Indiana Northern Traction Co. The company proposes to build from Wabash to North Manchester, as an extension of its line now in operation between Marion and Wabash.

Wabash, Ind.—The Indiana Northern Traction Co. will probably soon let contracts for the construction of a grade for a line between Wabash and North Manchester.

**Ft. Wayne, Ind.*—The contract for grading the Ft. Wayne, Bluffton & Marion Traction Company's line between Ft. Wayne and Bluffton, is reported to have been awarded to the L. E. Meyers Co., of Chicago, Ill., and for the bridges and culverts to H. W. Tupp, of Ft. Wayne.

**Bluffton, Ind.*—The Muncie, Hartford & Ft. Wayne Traction Co. is stated to have awarded the contract for construction of its line between Bluffton and Ft. Wayne to Hayes Sons, of Cleveland, O.

Des Moines, Ia.—Surveyors for the Interurban Ry. Co. are reported to be prospecting for an extension from Woodward to Boone. It is the intention to construct to power stations along the Perry line.

Sioux City, Ia.—D. Montgomery, Herman Eilers, Wm. L. McAuliff and others are reported interested in the construction of a railroad from Sioux City to Ireton, Ia.

**Alexandria, La.*—The directors of the Alexandria Electric Street Car Co. are reported to have awarded to G. U. Borde, of New Orleans, the contract to build the line. Work will commence in 60 days; 4½ miles are to be built in 12 months and the balance as soon as practicable.

South Haven, Mich.—The South Haven Traction Co. is reported formed to build a road from Saugatuck to Watervliet. Wm. E. Dodson, J. H. Dodson and Jos. W. Hosmer are reported interested.

Kalamazoo, Mich.—The Kalamazoo, Lake Shore & Chicago Traction Co., heretofore known as the Dunkley-Williams Co., is reported incorporated with a capital of $500,000 by S. J. Dunkley and W. R. Beebe, Kalamazoo; C. W. Williams, South Haven, and others. Preliminary work is completed, and the company expects to have 30 miles of rails laid by October 1.

Grand Rapids, Mich.—Jer. Boynton is reported interested in the construction of an electric line from Grand Rapids to Alpena. The road is to touch Greenville, Edmore, Winn and Mt. Pleasant. From Winn it is planned to build a line to Saginaw. A water power near Six Lakes in Montcalm County, has been purchased. The line is also to run from Grand Rapids to Grand Haven, utilizing the old roadbed of the Chicago & Central Michigan; capital, $2,000,000.

Jefferson City, Mo.—The Mississippi Valley Electric Ry. Co. is reported incorporated, with a capital of $650,000. The road will run from Kansas City to St. Joseph, with spurs extending to Leavenworth and Atchison; length of road will be about 65 miles. Directors: Chas. P. Breen and H. B. McAfee, of Parkville, Mo., and Geo. B. Blanchard, of New York, N. Y.

St. Louis, Mo.—Business men of St. Louis County are reported to have applied for a charter for an electric line to connect Jefferson City with Valley Park, the route of which will pass through Eureka, Allenton, Pacific and intervening towns. J. F. Sensenbrenner, of Viola Heights; M. D. Lewis, of Crescent Station; Dr. L. R. Monroe, of Eureka, and F. Merryle, of Allentown ,are reported interested. It is planned to have the line connect with those already existing in St. Louis, while an extension to Kansas City is also proposed.

Buffalo, N. Y.—The Buffalo, Lockport & Rochester Ry. Co., a recent consolidation of the Albion Electric, the Albion & Rochester and the Albion & Lockport Ry. companies, is reported incorporated with a capital of $590,000. F. B. Griffith, Jr., and Chas. B. Hill, Buffalo; Geo. B. Church, Albion, and R. A. Adams, Rochester, are the directors.

Lorain, O.—The Suburban Improvement Co., of Cleveland, is reported to be securing right of way for a new electric line from Cleveland to South Lorain.

Cincinnati, O.—F. E. Seagrave, of Toledo, W. A. Calhoun and J. N. Gardner, of New York, are reported interested in a proposition to buy the Cincinnati, Georgetown & Portsmouth Ry. and the Ohio River & Columbus Ry., the latter a steam road, and then build from Ripley to Aberdeen, where connection would be made with Maysville, Ky. From Maysville they propose to build to Mt. Olivet, Millersburg, Blue Lick Springs, connecting at Paris with the system of the Blue Grass Traction Company, making a continuous line from Lexington, Ky., to Cincinnati.

Newark, O.—Dr. F. J. Shontz and F. F. Elliott, of Martinsburg, promoters of the Newark, Martinsburg & Mt. Vernon Ry., are reported to have secured a franchise in Mt. Vernon and a grant is being asked for in Newark.

Akron, O.—Thos. L. Childs is reported to be working on financing his proposed road from Akron to Barberton, Canal Fulton, Orrville and Massillon.

Lowell, O.—Citizens of Lowell are reported to have agreed to give financial assistance to induce the Parkersburg, Marietta & Interurban Ry. to extend its line from Marietta to Lowell.

Canton, O.—The Canton-Akron Ry. Co. is considering requests made by the citizens of Dalton to build a spur line from Massillon to that place.

Lima, O.—F. O. Oleson, promoter of the Sandusky Southwestern Ry. Co. is reported to have asked Co. Comrs. for a franchise through the county.

Toledo, O.—The Patrick Hirsh Co., of Toledo, which is financing the Toledo, Ann Arbor & Detroit Ry., will, it is reported, shortly place contracts for the entire equipment. Contracts for overhead work and grading have already been closed with the Fidelity Constr. Co., of Detroit, Mich. The main power station will be located at Petersburg, Mich., for which the following will be purchased: Two 75-h.p. cross-compound condensing engines with jet condensers, two 550-k.w. 370-volt a. c. generators, four 300-h.p. boilers, a self-supporting steel stack, two 400-k.w. rotary converter outfits, with other main station and sub-station equipment. There will also be purchased poles, tires and rails for 42 miles of track, one large steel bridge and 16 to 18 smaller ones, also equipment for repair shop.

Panama.—Bids will be received by R. Chiari, Municipal Treas. at Panama, on July 24, for the construction of an electric tramway in the city of Panama. The line will have a starting point from the Plaza de Armas, following a course along carreras Nacional, Picaurte, Bolivar, Constitucion and Ithmo up to the new station of the Panama R. R. Co., the public market and the cemeteries.

Chambersburg, Pa.—The Chambersburg & Gettysburg Electric Ry. Co. is stated to have decided to extend its system from this place to Greencastle, Middleburg and the state line; also to New Franklin and Brown's Mills.

Bethlehem, Pa.—The Town Council has granted the petition of the Hanover Electric Street Ry. Co. for an extension of the franchise limit one year, and an amendment in the original route from 3d Ave. to 4th Ave.

**Bloomsburg, Pa.*—The Bloomsburg & Millville Electric Ry. Co. is reported to have given a mortgage to the Commonwealth Trust Co., of Harrisburg, for $250,000, and the construction of the line by Contractor T. H. Regan, of Philadelphia, will now proceed.

Mechanicsburg, Pa.—It is reported that work on the conversion of the Dillsburg & Mechanicsburg branch line of the Cumberland Valley R. R., from a steam to an electric line will shortly be commenced. The branch connects with the main line a short distance from the town. It is ¾ of a mile long and of standard gauge.

Royalton, Pa.—The Royalton & Elizabethtown St. Ry. Co. has been chartered by Wm. Trimble, S. L. Hibbard, Jr., C. H. Johnson and others.

Middletown, Pa.—The Town Council is reported to have passed the ordinance granting a franchise to the Philadelphia, Lancaster & Harrisburg Electric Passenger Ry. Co.

Lancaster, Pa.—The Lancaster & Eastern Electric Ry. Co. is stated to have been directed to proceed at once with the construction of the line from this city to Christianana Gap. The company will build a bridge over the Conestoga Creek south of Witmer's, and also a bridge just east of Leaman Place.

**Items marked thus give the names of parties awarded contracts.*

Sioux Falls, S. D.—The South Dakota Traction Co. is reported incorporated by C. M. Harrison, of Chicago, Ill., and others, to construct a street railway; capital, $500,000.

Snohomish, Wash.—All interests in the Snohomish & Cherry Valley, Ry. are reported to have passed from the control of the original promoters into that of a new company to be organized among local capitalists, in which Mayor C. S. LaForge, J. B. Brown and Victor Marshall, of Snohomish, are reported interested.

RAILROADS.

Notes Arranged Alphabetically by States.

Malvern, Ark.—The Malvern & Freeo Valley Ry. Co. has been incorporated, with a capital of $32,000, to build a line from Walco, on the Iron Mountain Road, in Hot Springs County, to Lono, a distance of 16 miles. Incorporators: H. H. Foster, Little Rock; N. P. Richmond and D. S. McCray, Malvern; John Landers, Springfield, Mo. ,and others.

**Gifford, Ark.*—The Gifford & Southeastern R. R. Co. has been incorporated, to build a line from Gifford, on the St. Louis, Iron Mountain & Southern R. R., through Hot Spring County to Stewart, a distance of about 7 miles; capital $25,000. Incorporators: G. E. Mattison and N. A. Webster, Gifford; N. P. Richmond and T. R. McHenry, Malvern, and others.

Columbus, Ga.—The Central of Georgia Ry. Co. (Henry M. Steele, Ch. Engr., Savannah) is reported to be having surveys made on its Columbus & Rome branch, preliminary to broadening the gauge of that road, and also making the extension from Greenville to Newnan.

Carrollton, Ga.—The Atlantic & Birmingham R. R. Co. (Geo. D. Wadley, Gen. Mgr., Waycross) is reported to have decided to commence at once a survey for a line from Carrollton to Atlanta.

Boise, Idaho.—The Colorado, Wyoming & Idaho R. R. Co. has been incorporated with a capital of $10,000,000, to build a railroad from Denver north to Laramie and west to St. Anthony and Boise. W. R. West, Laramie, Wyo.; E. S. Chroweth, McCracken, Kan.; Frank H. Stuart, of Boston, Mass.; John D. Milliken, of McPherson, Kan., and others.

Jasper, Ind.—The Southern Ry. Co. (D. W. Lum, Ch. Engr., Washington, D. C.) is reported to have decided to build an extension from Jasper to French Lick.

Muskogee, Ind. Ter.—A charter has been granted to the Muskogee & Texas Ry. Co. to construct a line, with a capital of $4,000,000, from Cushing Okla., to Honey Grove, Tex., 250 miles. Incorporators: Horace Speed and Thos. J. Lowe, of Guthrie, Okla. Ter.; Walter Eaton and Norman R. Haskell, of Muskogee, and others.

Iowa Falls, Ia.—The St. Paul & Des Moines R. R. Co. is reported incorporated with a capital of $1,000,000 to build north from Iowa Falls to the state line. Headquarters will be Iowa Falls. Incorporators: E. S. Ellsworth and Wm. Weldon, of Iowa Falls; and G. A. W. Dodge, of Boston, Mass.

Corbin, Ky.—The Louisville & Nashville R. C. Co. (W. M. Courtenay, Ch. Engr., Louisville, Ky.) is reported to be preparing to make extensive improvements on its Knoxville division between Corbin and Livingston.

**New Orleans, La.*—W. J. Oliver, of Knoxville, Tenn., is stated to have secured the contract for constructing about 40 miles of line for the New Orleans & Great Northern R. R. Co.

Baltimore, Md.—Press reports state that the engineers of the Baltimore & Ohio R. R. (D. D. Carothers, Ch. Engr., Baltimore, Md.) and the Pennsylvania R. R. (W. H. Brown, Ch. Engr., Philadelphia, Pa.) are considering tentative plans for belt lines around this city for the moving of freight traffic so as not to congest the tunnels under the city. Engineers have suggested to the Baltimore & Ohio management a scheme for a tunnel under the harbor to connect the Locust Point terminals direct with the road to Philadelphia. The work would cost about $3,000,000.

Baltimore, Md.—The Pennsylvania R. R. Co. (W. H. Brown, Ch. Engr., Philadelphia, Pa.) is reported to be considering the construction of an 8-mile double-track freight road around the city to the north, connecting with the track of the Philadelphia, Baltimore & Washington R. R. at Stemmers Run on the southeast, and at Frederick Road Station on the southwest; probable cost, $350,000.

Ellicott City, Md.—Surveys are reported to have been completed by the Baltimore & Ohio R. R. (D. D. Carothers, Ch. Engr., Baltimore, Md.) for improvements along the main line west of Ellicott City. The improvements will include two iron bridges over Patapsco River, one at Alberton and the other near Davis Station; also two tunnels, one through a bluff on the Baltimore County side 1,000 ft. in length, and another on the Howard County side, 500 ft. long.

Clinton, Mass.—The Court has appointed a special commission on the abolition of grade crossings in Clinton, consisting of Jas. A. Stiles, W. E. McClintock and Geo. W. Higgin; Engineer, F. W. Bateman, of Clinton.

Jersey City, N. J.—Mayor Fagan has vetoed the resolution recently passed by the Street and Water Bd. granting a vacation of the streets to the Erie R. R. Co., to construct an open cut and make terminal improvements.

New York, N. Y.—A. W. Stump, 26 B'way, would like to correspond with large railroad contractors and subcontractors, and desires them to state their plant, capital and experience, as he may want their figures on large railway contracts.

Canonsburg, Pa.—The Pennsylvania R. R. Co. (W. H. Brown, Ch. Engr., Philadelphia, Pa.) is reported to be preparing to build a line to connect the Chartiers and Millers Run valleys, the terminals being at Canonsburg and Bishop.

Philadelphia, Pa.—The Common Council on June 28 concurred in a resolution from Select Council to appoint five members from each body as a committee to act with Mayor Weaver, on the questing of abolishing grade crossings.

Minot, S. D.—L. M. Davis, of Minot, writes regarding the construction of a railroad from Minot to Bismark, that there will be nothing done this year beyond making surveys and securing rights of way.

Beaumont, Tex.—The Beaumont & Great Northern R. R. Co. has been incorporated, with a capital of $370,000, to construct a railroad from Trinity to Livingston, a distance of 37 miles. Incorporators: Wm. Carlisle, Atchison, Kan; Jas. E. Hill and L. T. Sloan, of Livingston, and others.

Grundy, Va.—The Buchanan & Tazewell Ry. Co. is reported incorporated, by John F. Hager, G. F. Hager and M. F. Flemming, all of Ashland, Ky., to maintain and operate a railroad in the State of Virginia.

Richmond, Va.—A charter has been granted to the Tidewater & Western Ry. Co., with a capital of $100,000. Thos. E. Jeffress is Pres.; G. M. Wilson, Sec., and T. M. R. Talcott, Gen. Mgr., all of Richmond. The directors also include several other Richmond men, who recently purchased the Farmville & Powhattan R. R., extending from Farmville, Va., to Bermuda Hundred. It is said the company may extend the road to Danville and Lynchburg.

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

Mobile, Ala.—Bids will be received until Aug. 1 by Maj. W. E. Craighill, Corps Engrs., U. S. A., for furnishing materials and constructing a light tower, 3 keepers' dwellings, an oil house, 3 storehouses, a wharf, fences and plank walks for Hillsboro Inlet Light Station, Fla.

Newport, Ark.—Bids are wanted until July 29 to erect a jail here. Address Alcorn Ferguson, Comr., or E. L. Boyce, Co. Judge, Newport.

Fresno, Cal.—W. H. Ryan, City Clk., writes that three sets of plans were viewed on June 19 and are now under consideration for a city hall to cost $75,000. When plans are accepted an election will be held to vote on issuing bonds for same.

Denver, Colo.—Thos. Harrison is reported to have decided to erect an apartment house at 20th Ave., Welton St. and Broadway, at a cost of $100,000; Quayle & Rice, Archts.

Washington, D. C.—The following bids are stated to have been opened on July 1 at the office of Capt. Chester Hartford for constructing superstructure of the municipal building: J. L. Parsons, of Washington, $995,000; General Supply & Constr. Co., of New York, N. Y., $1,000,900; A. B. Stannard, of New York, N. Y., $1,079,900; W. E. Spier, of Washington, $1,012,000; John Gill, of Cleveland, O., $1,121,400; J. C. Robinson, of Chicago, $1,129,800; H. Smith & Sons Co., of Baltimore, Md., $1,169,000; Noel Constr. Co., of Baltimore, Md., $1,183,588; Doyle & Doak, of Philadelphia, Pa., $1,218,830, and Brennan Constr. Co., Washington, $1,272,731. Each bid contains certain modifications and reductions.

**Ft. Screven, Ga.*—Capt. Jos. Davidson, Q. M., U. S. A., Savannah, writes that the contract for erecting a hospital at Ft. Screven (bids opened June 8) has been awarded to T. C. Dickson, Box 311, Savannah.

Cedartown, Ga.—Bids will be received until Aug. 14 by the Bd. Co. Comrs. (John L. Branch, Chmn.) for improving and repairing the Co. Court House; Bruce Architectural Co., Archt., Atlanta.

Moline, Ill.—L. M. Drack is stated to have prepared plans for a 4-story 116x52 ft. office building, to be erected here by Dere & Mansur Co.

Chicago, Ill.—It is stated that the Pere Marquette R. R. Co. (C. A. Wilson, Ch. Engr.) will erect a freight house 800 ft. in length at Harrison and Franklin St., at a cost of $200,000.

Chicago, Ill.—Bids will be received July 17 by the Dept. Pub. Wks. (Jos. M. Patterson, Comr.) for furnishing materials and doing all the iron work necessary to erect a 2-story and basement stone and brick fire engine house at Michigan Ave. and 14th St.; separate bids will be received same date for all the cut stone work; also for steam heating, all in said building.

Indianapolis, Ind.—It is stated that the Indianapolis Maennerchor Society has purchased a site at Illinois and Michigan Sts., for the erection of a 4-story building to cost $150,000.

**Indianapolis, Ind.*—The contract for erecting 7 cottages, a school, power house and refrigerator plant at the Industrial School for Girls, 5 miles distant from here, is stated to have been awarded to John R. Warren & Co., of Indianapolis, at $174,000. The contract for electric wiring and mechanical equipment is reported to have been awarded to Cheyenne Electrical Co., of Indianapolis, for $9,178. According to reports new bids will be received for heating, as the bids were rejected, being too high.

**Shelbyville, Ind.*—The Bd. County Comrs. is stated to have awarded on June 28 the contract for installing a steam heating plant in the court house and jail to Johnson & Son, of Indianapolis, for $5,016.

**Richmond, Ind.*—The Comrs. of Wayne County are stated to have awarded on June 28 the contract for installing the heating plant in the court house and jail to Zoller & Craighead, of Richmond, for $7,183.

Sioux City, Ia.—It is reported that the Bekins Van & Storage Co. will erect a fireproof building at W. 4th and Perry Sts.; probable cost $50,000.

Davenport, Ia.—It is stated that a hotel will be erected at 4th and Main Sts., at a cost of $300,000. Chris. Neipp, of the St. James Hotel, is reported interested.

Des, Moines, Ia.—It is stated that F. M. Hubbell is considering erecting a 6 or 8-story building here for the Merchants' Transfer Co.; W. L. Hinds, Pres.

**Atlantic, Ia.*—Butler Bros., of St. Paul, Minn., have secured the contract for constructing complete U. S. Post Office at Atlantic, for $24,380.

Lake Charles, La.—Lake Charles Lodge, No. 165, F. and A. M., is stated to have decided to build a 3-story brick building, to cost about $25,000.

Baltimore, Md.—It is stated that D. W. & G. N. Thomas will erect a 5-story warehouse at 28 Light St. for L. C. Basshor, to cost $26,000.

The contract for the 5-story warehouse to be erected on Eutaw and West Sts. for Wm. Knabe & Co., is stated to have been awarded to Henry S. Rippel. The contract for the fireproofing is reported to have been awarded to the Baltimore Ferro-Concrete Company. The structure will cost about $120,000, and was designed by Dodge & Day, of Philadelphia.

Baltimore, Md.—Bids will be received until July 17 by the Bldg. Com. (John M. Carter, Chmn.) for excavation, concrete footings, foundation walls and waterproofing of the new building to be erected for the Maryland Inst. for the Promotion of the Mechanic Arts.

**Holyoke, Mass.*—Casper Range, 10 Bond St., has secured the contract for a brick addition to the factory of White & Wyckoff. The plans call for two additional stories to the entire plant, which is 250x80 ft.

Grosse Pointe, Mich.—The Country Club is stated to have decided to erect a club house here, at a cost of $125,800. Chas. M. Swift is reported interested.

St. Paul, Minn.—A permit has been issued to the American District Steam Co. for a power plant building to be erected on W. 3d and Market Sts., to cost $125,000.

A permit has been issued to Peterson Burkhardt for a 4-story brick and stone building to be erected on 5th and Cedar Sts., to cost $50,000.

Springfield, Mo.—Stewart, Schmook & Culler are having plans prepared for the erection of a 3-story brick mercantile building at South and Walnut Sts.; it will be 100x117½ ft. with concrete basement and foundation walls.

Kansas City, Mo.—See "Power Plants, Gas and Electricity."

North Bergen, N. J.—The citizens are stated to have voted to issue $50,000 bonds for erecting a town hall.

Trenton, N. J.—Bids will be received until July 11 by the Bldg. Comn. (Jas. E. Mitchell, Chmn.) for furnishing materials and erecting a new wing at the State Prison.

**Arlington, N. J.*—Salmond Bros., 167 Midland Ave., are stated to have received the contract for erecting a 3-story brick building on Devonshire St. and Laurel Ave., for the Essex Pearl Button Co., of Newark, for $100,000.

New York, N. Y.—Bids will be received until July 13 by the Park Bd. (John J. Pallas, Pres.) for furnishing materials, erecting and completing a glass court for the bird house in the Zoological Park, in Bronx Park.

*The Remington & Sherman Co., 38 Park Pl., has secured the contract for alterations in certain rooms; also for electric equipment, plumbing, heating, fireproofing, etc., for the completion of the Hall of Records (bids opened June 22) for $1,328,426.

The Bd. of Estimate on June 30 appropriated $490,000 for enlarging the buildings of the Metropolitan Museum of Art.

Bids will be received until July 17 by John W. Brannan, Pres. Bd. Trus., for all the labor and materials required for the plumbing, drainage and other work for Pavilions A and B of the new Bellevue Hospital, 1st Ave. and 26th St., Boro. Manhattan.

Plans have been filed for a 3-story br. and stone dormitory to be erected on Blackwell's Island for the City of New York at a cost of $53,000. Wm. Flanagan, Archt., foot of E. 26th St.

Buffalo, N. Y.—Bids will be received until July 14 by the Dept. Pub. Wks. (Francis G. Ward, Comr.) for fireproofing and otherwise improving the present building, or buildings, now in use as a pumping station, near foot of Massachusetts Ave., including masonry, cut stone, roofing, sheet metal work, iron and steel work, plumbing, etc.

Bids will be received until July 11 by Alonzo G. Hinkley, Clk., Bd. Co. Superv., for furnishing materials and constructing concrete floors, plumbing, metal work, certain brick work, etc., for the 65th Regt. Armory, N. G. N. Y.

Niagara Falls, N. Y.—The following are the bids opened on June 26 by the Superv. Archt., Treas. Dept., Washington, D. C., for the construction complete of U. S. Post Office at Niagara Falls: Wm. Weber, Huntington, $105,000; L. C. Wilke, Lockport, $119,612; Morris & Allen, Buffalo, $109,743; Henry Shenck Co., Erie, Pa. $99,925; The General Supply & Constr. Co., New York, $89,869; Braas Bros. Co., Niagara Falls, $112,500; Gibbs & Schaaf Co., Buffalo, $102,353; Cramp & Co., Philadelphia, Pa., $85,707; Thos. Reiley, Philadelphia, Pa., $94,969; John Frank & Sons, Cleveland, $91,450; A. B. Storman, New York, $98,531; Fissel & Wagner, New York, $83,800, and Richardson & Burgess, Washington, D. C., $75,000.

**Raleigh, N. C.*—Jas. McKee, Supt. State Hospital, writes that the contract for erecting a wing to the State Hospital (bids opened June 14) has been awarded to W. B. Barrow, of Raleigh, for $36,778.

Grand Forks, N. D.—The following are bids opened June 27 by the Superv. Archt., Treas. Dept., Washington, D. C., for furnishing the steam heating apparatus complete for U. S. Post Office at Grand Forks: Spriggs Bros., Grand Forks, $6,486; Fargo Plmg. & Hting Co., Fargo, $5,470; Iowa Mfg. Co, Oskaloosa, Ia., $4,504; G. A. Kees C. & Eng. Co., St. Paul, Minn., $4,695; T. M. McGuire, Minneapolis, Minn., $4,889; F. L. Dixon, Grand Forks, $5,895; Butler Bros., St. Paul, Minn., $5,000; Pond & Hosey Co., Minneapolis, Minn., $4,444; The Dwyer Plumbing & Heating Co., St. Paul, Minn., $4,895, and Allen Black Co., St. Paul, Minn., $4,987.

Washburn, N. D.—Bids will be received until July 24 by the Bd. Co. Comrs. for furnishing materials and erecting a court house; O. B. Wing, Co. Aud.

Cleveland, O.—The Dime Savings & Banking Co. is reported to be having plans prepared for a building to be erected on the Public Square, at a cost of about $600,000.

Cincinnati, O.—Bids will be received until July 26 by the Bd. Pub. Service (Geo. F. Holmes. Clk.) for furnishing engine, generator, boiler, feed-water heater, switchboard and electric wiring, raising stack, piping and boiler feed pumps complete for City Warehouse.

Cleveland, O.—Bids will be received until July 29 by the Public Library Bd. (Carl Lorenz, Secy.) for furnishing materials and erecting, including plumbing, heating, gas-fitting and electric wiring a public library on Crawford Road near Hough Ave.; Frank B. Meade and Abram Garfield, Archts., 1002 and 915 Garfield Bldg.

****Items marked thus give the names of parties awarded contracts.***

**Pittsburg, Pa.*—T. H. Scott has awarded to Geo. A. Fuller Co., Farmer's Bank Bldg., the contract for constructing an office building at 221 4th Ave., for the Jones estate; building will be of brick, marble and terra cotta, 19 stories, 60x80 ft., and cost $500,000.

Pittsburg, Pa.—McClure & Spahr are stated to be preparing plans for a brick addition to be erected to the Home for Incurables on Butler St., to cost $20,000.

Philadelphia, Pa.—It is stated that Arnold H. Moses, 136 S. 4th St., will soon receive bids for a kitchen building and 2 additional ward buildings at the Samaritan Hospital at Broad and Ontario Sts., to cost about $50,000.

Bristol, Va.—The Y. M. C. A. Assoc. is stated to have purchased a site at 5th and Shelby Sts., for the erection of a building to cost about $35,000; V. T. Grizzard, Secy.

West Chester, Pa.—The following are the bids opened on June 28 by the Superv. Archt., Treas. Dept., Washington, D. C., for construction complete U. S. Post Office at West Chester: Farrell & Wagner, New York, N. Y., $36,000; Chas. McCaul Co., Philadelphia, $34,996; Thomas Reilly, Philadelphia, $37,911; Cramp & Co., Philadelphia, $35,567; G. F. Guthrie, Downington, $34,900; King Lumber Co., Charlottesville, Va., $44,769, and W. H. Burns, West Chester, $39,770.

**Ft. Myer, Va.*—The contract for erecting a building for bachelor officers' quarters at Ft. Myer (bids opened June 24) is stated to have been awarded to Jos. S. Reynolds, of Washington, for about $40,000.

**Ft. Wright, Wash.*—Capt. A. E. Shuttleworth, Constr. Q. M., U. S. A., Spokane, writes that Erb & Van Patten, of Salem, Ore., have secured the contract for constructing 3 officers' quarters (bids opened June 15) for $67,095, and P. C. McCaffrey, of Spokane, for plumbing same at $6,367. Bids for other buildings opened at this time have been rejected and new bids were to have been opened July 7.

Milwaukee, Wis.—Olivia Drew is stated to have secured a building permit for the erection of a 4-story flat building at Eighth and Cedar Sts; estimated cost, $30,000.

Ft. MacKenzie, Wyo.—Bids will be received by Capt. Jas. S. Parker, Q. M., U. S. A., at Sheridan, July 24, for constructing, plumbing, heating and electric wiring numerous buildings for Ft. MacKenzie, as advertised in The Engineering Record.

Guelph, Ont.—Bids will be received until July 17 by the Dept. Pub. Wks., Ottawa (Fred Gelinas, Secy.) for constructing an armory at Guelph.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

San Francisco, Cal.—It is reported that the California Wine Assoc. will erect a 2-story, 80x125-ft. brick storage building at Townsend and Clarence Sts.

Putnam, Conn.—It is stated that the New York, New Haven & Hartford R. R. Co. (Colin M. Ingersoll, Ch. Engr., New Haven) will erect a station here, to cost $80,000.

Evansville, Ind.—It is stated that Hulman & Co., of Terre Haute, have purchased a site near the Union Depot in Evansville for the erection of a $100,000 warehouse. According to reports, bids will be invited as soon as plans can be made.

Chicago, Ill.—A permit is stated to have been issued for the erection of a 12-story building at 145 Michigan Ave. for the New Illinois Athletic Club, at a cost of $600,000.

It is stated that the Chicago & Western Indiana R. R. Co. is having plans prepared for two stations, one to be erected at 47th and Wallace Sts. and the second at Garfield Boule. and Wallace St.

Sioux City, Iowa.—Reinecke & Jenkinson are stated to have prepared plans for a 3-story, 100x150-ft. building, to be erected at 4th and Jones Sts. at a cost of $100,000.

Ann Arbor, Mich.—The construction of a theater here, at a probable cost of $50,000, is reported contemplated by W. L. Butterfield.

**Joplin, Mo.*—Deiter & Wenzel, of Joplin, are stated to have received the contract for erecting a 3-story, brick building at Dougherty and Main Sts. for the Merchants and Miners' Bank and O. C. Zaumseill for $25,000.

**Rochester, N. Y.*—F. D. Hyde, of New York, is stated to have received the contract for erecting a station at the Court St. Bridge for $117,000.

**Buffalo, N. Y.*—The Lincoln Improv. Co. is stated to have awarded to S. H. Woodruff the contract for erecting a business and power block at Main and Utica Sts., at a cost of $160,000.

Tiffin, O.—The Jr. O. U. A. M. is stated to have appointed a committee, with Dr. H. L. Wenner, Chmn., to erect a building 56x176 ft., to contain lodge room, auditorium, swimming pool, etc.

Allegheny, Pa.—It is stated that bids will be received until July 12 by Price & McLanahan, Archts., 1624 Walnut St., Philadelphia, for a 4-story brick and steel fireproof passenger station for the Pennsylvania R. R.; probable cost, $150,000.

Pittsburg, Pa.—It is stated that Leopold Vilsack will erect an 8-story brick warehouse at 2d Ave. and Wood St., at a cost of about $138,000.

New York, N. Y.

69 Bank St., 4-story br. and stone factory c, $40,000; o, R. E. & G. Schirmer; a, Howard Chapman.

92 Cherry St., 5-story br. and stone settlement workhouse. c, $50,000; o, The Salvation Army; a, W. G. Piqueron.

14th St. and Ave. B, 6-story br. and stone store and tenement; c, $45,000; o, Aaron Segal; a, Horenburger & Straub.

447 W. 14th St., 6-story br. and stone factory; c, $200,000; o, American Can Co.; a, Jas B. Baker.

530 W. 27th St., 2-story br. and stone warehouse; c, $20,000; o, Edward H. Lyons; a, Ralph E. Dusinberie.

13 W. 34th St., 5-story br. and stone store and loft building; c, $70,000; o, Robt. Smith; a, F. A. Minuth.

291 7th Ave., 10-story br. and stone loft building; c, $125,000; o and a, Albert C. Hessel.

119th St. and 1st Ave., 2 6-story br. and stone store and loft buildings; total c, $70,000; o, Sampert & Schwartz; a, B. W. Levitan.

215 E. 121st St., 6-story br. and stone store and tenement; c, $50,000; o, Peck & Sevboloff; a, B. W. Levintan.

110th St. and 2d Ave., 4 6-story br. and stone store and tenements; total c, $140,000; o, A. D. Weinstein; a, Horenburger & Straub.

132 E. 110th St., 6-story br. and stone store and tenement; c, $35,000; o, Saml Sindeland; a, Horenburger & Straub.

158th St. and Union Ave., 6-story br. stores and tenements; c, $60,000; o, Max Sternberg; a, Goldner & Goldberg.

381 Broome St., 7-story br. and stone extension to 5-story br. and stone loft building; c, $25,000; o, Dominisk Saladino; a, Kurtzer & Rentz.

CHURCHES AND DWELLINGS.

Notes Arranged Alphabetically by States.

San Francisco, Cal.—The congregation of Emanu-El will erect a temple on Van Ness Ave. and Sutter St., to cost $1,000,000.

Denver, Colo.—Quayle & Rice are reported to be preparing plans for a 210x160 ft. brick apartment house to be erected at 20th Ave., Welton St. and B'way for Thos. Harrison, at a cost of $100,000.

Bridgeport, Conn.—It is stated that the Catholic Society of St. Michael will erect a church, at a cost of $100,000. Rev. W. A. Becker, pastor.

Atlanta, Ga.—Gude & Walker, 713 Prudential Bldg., are stated to have received the contract for erecting an edifice for Grace Methodist Church, to cost $40,000.

**Worcester, Mass.*—Jos. A. McDermott, of Worcester, is stated to have received the contract for erecting the Polish Church at Richland and Ward Sts., for about $30,000.

The contract for erecting an edifice for the congregation of the First Baptist Church is stated to have been awarded to P. W. Finn, of New York, N. Y., for $97,000.

New York, N. Y.—Plans for the brick and stone church to be erected at Mt. Morris Park West and 122d St. for the congregation of Harlem Presbyterian Church have been filed. The structure is to cost $95,000. T. H. Poole & Co., Archts., 13 W. 30th Sts.

Portland, Ore.—The First M. E. Society (South) is stated to have purchased a site for the erection of an edifice to cost $25,000.

Sharpsburg, Pa.—Bids are wanted until July 11 for erecting a school at Clay and Linden Sts.; Hall & Stevens, Archts., House Bldg., Pittsburg.

NEW YORK, N. Y.

Broome and Suffolk Sts., 6-story br. and stone tenement; c, $50,000; o, Louis Reiner; a, Bernstein & Bernstein.

Delancey and Suffolk Sts., 6-story br. and stone tenement; c, $25,000; o, D. Abrams. a, Bernstein & Bernstein.

110 Mott St., 6-story br. and stone tenement; c, $25,000; o, Angelo Julian; a, Chas. E. Reid.

117 E. 55th St., 5-story br. and stone residence; c, $25,000; o, Arthur K. Bourne; a, Pickering & Walker.

438 E. 117th St., 2 6-story br. and stone tenements; total c, $70,00; o, Empire Cornice Works; a, Bernstein & Bernstein.

440 E. 121st St., 2 6-story br. and stone tenements; total c, $65,000; o, Empire Cornice Works; a, Bernstein & Bernstein.

Hamilton and 141st St., 2 6-story br. and stone tenement; total c, $180,000; o, Schlesinger & Fenichel; a, Glasser & Ebert.

126th St. and 2d Ave., 3 6-story br. and stone stores and tenements; total c, $129,000; o, Rosalia Meli. a, Geo. F. Pelham.

49 W. 133d St., 6-story br. and stone tenement; c, $40,000; o, Max Miller; a, Wm. C. Sommerfield.

143d St. and Bway, 5-story br. and stone tenement; c, $75,000; o, Irwin A. Lewis; a, Moore & Landsiedel.

144th St. and Bway, 2 5-story br. and stone tenements; total c, $80,000; o, Psaty & Edelson; a, F. A. Meyers.

149th St. and 8th Ave., 6-story br. and stone tenement; c, $60,000; o, Frank Mueller; a, Rudolph Werner.

164th St. and Amsterdam Ave., 3 5-story br. and stone tenements; total c, $150,000; o, Wilson Gingold; a, B. W. Levitan.

138th St. and Willis Ave., 2 6-story br. tenements; total c, $96,000; o, Geo. M. Mosauer; a, Schwartz & Gross.

153d St. and Morris Ave., 5-story br. tenement; c, $40,000; o, John Pierce. a, M. J. Garvin.

182d St. and Washington Ave., 4 3-story br. tenements; total c, $42,000; o, Hillside Realty Co.; a, Chas. Baxter & Son.

Brook Ave. and 139th St., 5-story br. tenement; c, $55,000; o, Gumdusky & Cohen; a, Lorenz F. J. Weiher. $45,000; o, Chas. R. Piotze; a, Adolph Martin.

Prospect Ave. and 165th St., 5-story br. tenement; c,

SCHOOLS.

Notes Arranged Alphabetically by States.

Washington, D. C.—It is stated that bids will be received until Aug. 1 by A. O. Von Herhilis, Archt., 1416 F St., N. W., for erecting a 3-story, stone and brick, fireproof gymnasium for the Georgetown Univ.; probable cost, $50,000.

Wrightsville, Ga.—The plans of Chas. E. Choate, of Augusta, for the N. L. W. Institute building are stated to have been accepted by the Bd. of Trustees; the estimated cost of the structure is $22,000.

Chicago, Ill.—A permit is stated to have been issued for a 1-story addition to the school at 641 N. Monticello Ave.

**Cynthia, Ky.*—Raymond Bros. are stated to have received the contract to erect a school here for $40,000.

Lafayette, Ind.—It is reported that bids are wanted until July 12 for erecting a stone building for the Dept. Civil Engineering, Purdue Univ.; address the Secy. R. P. Daggett & Co., Archts., Marion Blk., Indianapolis.

**Shelbyville, Ind.*—Thos. Hawkins, Auditor, writes that the contract for installing steam heating plant in school (bids opened June 28) has been awarded to W. H. Johnson & Son Co., of Indianapolis, for $5,016.

Bloomington, Ind.—Bids are wanted Aug. 9 for the erection of a library on the campus of the Indiana University, as advertised in The Engineering Record.

Springfield Mass.—It is stated that bids will be received until July 14 by the Bd. Pub. Wks. for a new school in Ward 2; probable cost, $60,000.

Boston, Mass.—The Bd. of Aldermen is stated to have voted in favor of the $100,000 appropriation for a site for the Franklin Institute.

**Rushford, Minn.*—A. G. Lundblad, of Rushford, is stated to have received the contract for erecting a school here for $28,900

**Kansas City, Mo.*—J. R. Neeval is stated to have received the contract for erecting the Lincoln High School, for $47,466.

St. Louis, Mo.—The German Evangelical Lutheran Society is reported to have appropriated $30,000 toward the erection of a building for the St. Louis Theological Seminary.

Concord, N. H.—Plans will be received until July 21 by the Bldg. Com., for erecting a high school; DeWitt C. Howe, Chmn., Sub. Com. on Plans.

Hoboken, N. J.—The plans of Eugene Ciccarelli, 2d Natl. Bank Bldg., are stated to have been accepted for School No. 9.

New York, N. Y.—Plans have been filed for a 5-story brick and stone building to be erected at 84th St. and 2d Ave., at a cost of $160,000, for the Workman's Educational and Home Asso.; F. W. Fisher, Archt., 24 E. 23d St.

Bids will be received until July 17 by C. B. J. Snyder, Supt. School Bldgs., for general construction, etc., of addition to and alterations in School 52, Boro. Manhattan; also some date for the sanitary work and gasfitting of new School 40, Boro. Bronx.

Morgantown, N. C.—Wheeler, Runge & Dickey, of Charlotte, are reported to have been selected to prepare plans and specifications for a school to be erected here, at a cost of $20,000.

**Barnesville, O.*—Robt. H. Evans & Co., of Zanesville, are stated to have received the contract to erect school here for $33,237.

Cleveland, O.—Bids will be received July 31 by the Bd. Educ. (Geo. E. Myers, Clk.) for furnishing materials and installing a ventilating and heating apparatus in the Kentucky School, and in the annex of the Standard School.

Montpelier, O.—Bids will be received until July 20 by the Bd. Educ., Jefferson Township (C. C. Lloyd, Clk.) for erecting a school in Sub-Dist. No. 2.

Port Arthur, Tex.—A. M. Rutan, Secy. School Bd. writes that all bids opened June 20 for erecting a high and manual training school have been rejected and new bids will be received Aug. 1. Bids for the ventilating, heating, plumbing and electric wiring will be called for later on.

Spokane, Wash.—It is stated that the plans of Galbraith & Hols have been accepted for the Norwegian Lutheran College, to be erected in Spokane, at a cost of $35,000.

St. Croix Falls, Wis.—Bids will be received until July 14 by the Bldg. Com. (W. C. Reilly, Chmn., Osceola), for furnishing materials and erecting a teachers' training school at St. Croix Falls, the walls of said building to be constructed of hollow cement stone blocks, machine pressed.

STREET CLEANING AND GARBAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Chicago, Ill.—The following are the bids opened June 26 by the Comrs. of Pub. Wks. for the collection and removal of garbage: John Dowdle bid $590,000 for the year 1906 and $490,000 for each of the years 1907, 1908, 1909 and 1910. American Reduction Co., Pittsburg, Pa., bid $1,095,000 for 1906, $940,00 for 1907, $960,000 for 1908, $980,000 for 1909 and $995,000 for 1910.

Ann Arbor, Mich.—A committee consisting of Edwin W. Groves, City Engr. and three members of Council has been appointed to visit garbage crematories, with a view to constructing one in this city.

**New York, N. Y.*—The following are the bids opened on July 5 by the Dept. of Pub. Charities for furnishing material and constructing a garbage crematory on Randalls Island: Morse Boulger Destructor Co., 39 Cortlandt St., $4,800 (awarded contract); Sanitary Engr. Co., 237 Bway., $5,427, and Albert Winternitz, 237 E. 72d St., $5,400.

Philadelphia, Pa.—All bids opened May 4 for the collecting and disposal of garbage during 1906 have been rejected and it is reported that new bids will be received by the Bd. of Pub. Wks. on July 13. A. Lincoln Acker, Dir.

NEW INDUSTRIAL PLANTS.

See Also Business Buildings.

Olympia (Wash.) Brewing Co. has just begun the erection of a new brew house in connection with which is a storage house for malt and a cold storage for hops. Contract for the building has been let to Gribble, Skene & Barrett Co.; contract for machinery and equipment to Vilter Mfg. Co., Milwaukee, Wis. The Olympia Co. is in the market for electric motors and generators, and a number of steam traps and steam pressure-reducing valves.

John Faulkner & Son, chemical engineers, Bay City, Mich., are preparing to construct a large chemical plant to consist of main building, 350x120 ft., power plant, machine plant, lime kilns, etc. About 1,500 hp. will be required.

A correspondent writes that the Omaha Elevator Co., Council Bluffs, Ia., will shortly rebuild its elevator which was recently destroyed by fire.

**Items marked thus give the names of parties awarded contracts.*

Chattahoochee Chemical & Mining Co., Girard, Ga., is now engaged in rebuilding its plant, which was recently destroyed by fire, according to local newspaper reports. The new factory will cover a larger area and have a greater capacity than the old one.

Mr. I. F. McLean, Nashville, Tenn., will shortly establish a large stave and heading plant, according to local newspaper reports. It is stated that the new plant will employ 100 men, and the total amount of capital invested will be about $100,000.

The Twin City Rapid Transit Co., St. Paul, Minn., according to newspaper reports, has awarded to George Cook, of Minneapolis, contract for its new plant. It is understood that nine reinforced concrete buildings will be erected, including woodworking, machine and blacksmith shop.

The Washburn-Crosby Milling Co. will build a 4,000-bbl. flour mill in Kansas City, to cost $500,000, according to newspaper reports.

Santa Cruz (Cal.) Portland Cement Co. has been incorporated, with a capital of $5,000,000, and will construct extensive cement works, according to newspaper reports.

Crane Co., Chicago, Ill., has purchased property in Birmingham, Ala., on which they will erect a plant, according to newspaper reports.

The Nipe Bay Co. has let contract for the largest sugar factory in the world, to be erected in Cuba, according to newspaper reports.

Eldro Richardson, Baltimore, Md., is having plans prepared for an addition to his machine and brass works, according to newspaper reports.

Twin City Rapid Transit Co., St. Paul, Minn., has let contract for an extensive new plant which will be of reinforced concrete construction and include wood-working, machine and blacksmith shops and several others.

The Elizabeth Iron Works, Norfolk, Va., is reported to be in the market for punch and shears, steam hammer, radial drill, small pneumatic tools, traveling crane, and open side planer and boring mill.

Shippen Bros. Lumber Co., Ellijay, Ga., has recently added 30,000 acres of timber lands to its former holdings and is now doubling the capacity of its planing mill. This concern is also building a spur track which will open up an iron ore bed. The company also expects to begin shortly the development of marble quarries located near the plant.

The Warner & Swasey Co., Cleveland, O., is making additions to its present plant which will double its capacity. The new building will be 55x240 ft., five stories and of fireproof construction throughout. A power plant will also be installed.

The Great Western Sugar Co., Denver, Colo., is preparing plans for a sugar factory at Billings, Mont. The new plant will have a capacity of 1,000 tons per day.

Hardy Buggy Co., Paducah, Ky., is erecting a plant consisting of the following buildings: Shop and woodworking dept., 60x100 ft., and two additional buildings, 40x160 ft. and 48x75 ft., respectively. This plant will be supplied with power from city electrical supply.

Wood & Womble, Strong, Ark., cotton ginners and manufacturers of lumber and shingles, are adding to their sawmill plant and are in the market for 1 gang edger, 1 shingle mill and 1 turning lathe. This concern is also in the market for an electric lighting plant to supply 200 incandescent and 5 arc lamps for lighting their plant and the town of Strong.

Chas. A. Hoover will erect a $50,000 distillery at Oskaloosa, Ia., in the near future, according to local newspaper reports.

The Ernest Simons Mfg. Co., Port Chester, N. Y., will establish a large branch plant at Norwalk, Conn., for the manufacture of sheets and pillow cases, according to newspaper reports. Part of the plant of H. M. Loth Co. has been leased, and special machinery will be installed.

Lorraine Mfg. Co., Pawtucket, R. I., is planning additions to its cotton mill which will include a large weave shed, four-story cotton house and four-story addition to present mill.

R. F. Balke, Cincinnati, O., will erect a four-story, brick and stone building, to be used as a distillery, according to local newspaper reports. Cost of building will be $25,000.

The Atlantic (Ia.) Gas & Fuel Co. will install new machinery in its plant, according to newspaper reports.

The Booth Packing Co., Lincoln, Neb., will erect a warehouse and storage building, and will install refrigerating apparatus, according to newspaper reports.

New Liverpool Salt Co., Los Angeles, Cal., is planning to rebuild its plant, recently destroyed by water, according to newspaper reports.

The Hauser Packing Co., Los Angeles, Cal., is preparing plans for a $200,000 packing house, according to newspaper reports.

Merchants' Ice & Cold Storage Co., Los Angeles, Cal., will erect new ice-making plant, according to newspaper reports.

Refuge Cotton Oil Co., Columbus, Miss., has purchased land for the erection of a new plant, 200x100 ft., with a capacity for over 100 tons of product daily, according to newspaper reports. It is also reported that this company will also operate a steam ginnery in connection with the new plant.

The Modern Brick Co., Mexico City, Mex., has just been organized and will construct a plant capable of turning out 35,000 brick daily, according to local newspaper reports. Mr. C. M. Sandoval, general manager of the company, is reported to be in the United States now for the purpose of purchasing machinery.

Fulton (Ky.) Mfg. Co., recently incorporated, is about to double the capacity of its plant, according to newspaper reports.

The Brunswick-Balke-Collender Co., Chicago, Ill., is preparing plans for a factory to be erected at Long Island City, N. Y. This company has about completed the erection of a plant at San Francisco, Cal., which will employ about 200 hands, and is now ready to install machinery. The company is now considering a number of sections of the country, to one of which they expect to remove a portion of their Chicago plant.

The Wire & Telephone Co. of America, Rome, N. Y., recently organized, is contemplating the erection of a 200x50-ft., one-story, brick building.

The Caille Bros. Co., Detroit, Mich., is erecting an addition to its plant which will increase its floor space about 15,000 sq. ft.

S. S. Marvin & Sons, Pittsburg, Pa., will erect a 75x80-ft., six-story, reinforced concrete building, to be used as a chocolate factory. This company is in the market for belts, hangers, pulleys and elevators.

National Biscuit Co. is planning the erection of a large plant at Sioux City, Ia., according to newspaper reports.

The Granite Linen Co., Paterson, N. J., will build a temporary mill at Wortendyke to replace the one recently destroyed by fire, according to newspaper reports. The new mill is to be 50x150 ft., will contain 50 looms and be operated by electricity.

The Foster Bros. Mfg. Co., Utica, N. Y., is building a 100x87-ft. addition to its plant, according to newspaper reports.

Leesville Lumber & Mfg. Co. is erecting a plant for the manufacture of telephone and telegraph cross-arms, according to newspaper reports.

Kelly Bros., Haverhill, Mass., are planning an extensive addition to their present plant, which will be 48x116 ft., six stories high and cost $30,000, according to newspaper reports.

The McLain Lumber Co. is contemplating the erection of a $100,000 sawmill plant at Memphis, Tenn., according to newspaper reports.

The Morgan Machine Co., Rochester, N. Y., is about to erect a large plant, to cost $40,000, according to newspaper reports. The plans provide for a main shop, 287x122 ft.; two-story office building, 135x48 ft., and an additional building, 101x70 ft., which will contain engine and boiler room, blacksmith shop, etc.

The Anheuser-Busch Brewing Co. is preparing to establish a large cold-storage plant in New York City, according to newspaper reports.

The B. Schade Brewing Co., Spokane, Wash., is reported to have increased its capital from $150,000 to $250,000 with a view to improving its plant.

Robertson Doll Carriage Co., Denver, Colo., is planning a $75,000 addition to its plant, according to newspaper reports.

The McNeel Marble Co., Marietta, Ga., will establish a new marble plant in Columbia, Tenn., according to newspaper reports.

The Nebraska Flour Export Co., Lincoln, Neb., has been incorporated and expects to begin immediately the erection of a flour mill, to cost $25,000, according to newspaper reports.

The American Steel & Wire Co., Anderson, Ind., will make extensive improvements and repairs to its rod mill, according to newspaper reports.

Kokomo (Ind.) Flint Glass Co. will shortly rebuild its plant, which was recently destroyed by fire, according to newspaper reports.

The Jackson Medicine Co., Painesville, O., is planning the erection of a large manufacturing plant, according to newspaper reports.

Lowe Mfg. Co., Cleveland, O., has completed plans for an addition to its plant, according to newspaper reports. The new building will be constructed of brick and steel and will measure 46x202 ft.

Rogue River Mining, Smelting & Power Co., Portland, Ore., will erect a large smelter at Grant's Pass, Ore., according to newspaper reports. It is also reported that an electric plant capable of developing 45,000 h.p. will be built.

The Fisher Machine Works, Lawrence, Kan., is preparing to erect a $25,000 foundry and machine works, to be operated in connection with its present plant, according to newspaper reports.

The Hendey Machine Co., Torrington, Conn., is about to erect a brick, steel and cement building, 110x220 ft. The new building will be equipped with electric crane and will be used for general machine work.

Botany Worsted Mills, Passaic, N. J., are at present erecting a four-story building, to be used for spinning purposes. About 500-hp. will be required.

A. Kory & Sons, New Orleans, La., are about to erect a new factoory, 240x120 ft. The plant will be operated by slow-speed, alternating-current motors, from outside power supply. Later on this concern will install a power and lighting plant.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

Washington, D. C.—Bids will be received until Aug. 1 at the Bureau of Supplies and Accounts, Washington, D. C., for furnishing at the Navy Yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of naval supplies as follows: Motors; pig iron, steel; valves; steam traps; pipe fittings; sewer pipe and fittings, etc. H. T. B. Harris, Paymaster-Gen., U. S. N.

Savannah, Ga.—Bids are wanted Aug. 2 for dredging Skidaway Narrows, Ga., as advertised in The Engineering Record.

The following are the bids opened on June 30 by Lieut. Col. Jas. B. Quinn, Corps Engrs., U. S. A., for dredging harbor at Savannah, 175,000 cu. yd., *a* price per cu. yd., *b* total: N. A. Dredging Co., San Francisco, Cal., *a* 23 cts., *b* $40,250; Geo. W. Catt, New York, N. Y., *a* 17.4 cts., *b* $30,450; (recommended for acceptance); Southern Dredging Co., Mobile, Ala., *a* 20.2 cts., *b* $35,350.

Joliet, Ill.—The Joliet & Morris Canal Co., of Chicago, is reported incorporated with a capital of $100,000, to construct a canal from Joliet to Morris, Ill. Incorporators: Chas. A. Munroe, Geo. S. Steere and Carl A. Ross.

Portland, Ind.—It is reported that contracts will probably soon be let by the Co. Comrs. for dredging Lob ditch, a distance of 12 miles. Address County Auditor.

Portland, Me.—The following are the bids opened on June 30 by Maj. W. M. Black, Corps Engrs., U. S. A., for dredging in York Harbor: (*a*) 40,000 cu. yds. dredging, (*b*) removing boulders: Simon J. Donovan, *a* 31.5 cts., *b* $10. Hamilton & Sawyer, *a* 27.9 cts., *b* $4.

**Baltimore, Md.*—The Maryland Dredging & Contr. Co., of Baltimore, is stated to have secured the contract for dredging two sections of Patapsco River, for $501,139, and Chas. W. Eaton, of Haverhill, Mass., for the third section for $497,156 (bids opened June 20). The Maryland Dredging & Contr. Co. also secured the contract for dredging Susquehanna River near Havre de Grace, for $9,085.

Newton Upper Falls, Mass.—With a view of raising the height of Charles River at Newton Upper Falls and generally improving conditions along its banks, a plan is under consideration for the construction of a dam at Boylston St. It will be of concrete and cost about $40,000, to be paid for by Newton, Wellesley, Norfolk and Middlesex Counties, the Metropolitan Park Comn. of Boston and the Boston & Worcester St. Ry. Co.

Boston, Mass.—The following are the bids opened on June 27 by Col. W. S. Stanton, Corps Engrs., U. S. A., for dredging (*a*) Mystic River; (*b*) Malden River (price given per cu. yd.): Eastern Dredging Co., Boston, *a* 49 cts., *b* 47 cts., and Bay State Dredging Co., Boston, Mass., *a* 49 cts., *b* 48 cts. They each bid $5 per cu. yd. for removing bowlders.

**Duluth, Minn.*—The following are the bids opened by Maj. Chas. L. Potter, Corps Engrs., on June 27, for dredging in Portage Lake Ship Canals, Mich., (*a*) dredging in Sec. 1, 34,000 cu. yds., per cu. yd. scow meas.; (*b*) dredging in Sec. 2, 83,000 cu. yds., per cu. yd. scow meas.; (*c*) total: Great Lakes Dredging & Dock Co., Chicago, Ill., *a* 12½ cts., *b* 19½ cts., *c* $20,435; Lake Superior Contracting & Dredging Co., Duluth, Minn., *a* 12 cts., *b* 18 cts., *c* $19,020; Zenith Dredge Co., Duluth, Minn., *a* 15 cts., *b* 24 cts., *c* $25,020; James Pryor, Houghton, Mich., *a* 11 cts., *b* 17 cts., *c* $17,850 (awarded contract).

**Vicksburg, Miss.*—Donavan & Daley, of Lake Providence, La., on June 20, secured the contract for 92,900 cu. yd. levee work in Upper Tensas Levee Dist., at 29.9 cts. per cu. yd.

Greenville, Miss.—Bids will be received by the Bd. of Mississippi Levee Comrs. up to 4 P. M., July 10, for about 900,000 cu. yds. of levee work, as advertised in The Engineering Record.

New York, N. Y.—Bids will be received until July 12 by Louis F. Haffen, Pres. Boro. Bronx, for furnishing, erecting and maintaining for a period of 1 year, street signs and sign-posts in the Boro. Bronx. Engineer's estimate: 700 standards, each with 4 enameled signs, type A, B and C, complete; 950 frames for attachments to gas lanterns, each with 4 signs, complete, and 600 street sign-posts.

New York, N. Y.—Bids will be received until July 14 by the Dept. Docks and Ferries (Maurice Featherson, Comr.) for furnishing materials and erecting a pier between W. 42d and W. 43d Sts., to be known as Pier 83, North River, Boro. Manhattan.

Buffalo, N. Y.—Bids will be received until July 12 by the Dept. Pub. Wks., Francis G. Ward, Comr., for furnishing material and rebuilding the nose of Inlet Pier in Niagara River, at the foot of Massachusetts Ave. and for the extending same.

Cincinnati, O.—The following are the bids opened on June 30 by Lieut. Col. E. H. Ruffner, Corps Engrs., U. S. A., Cincinnati, for furnishing and delivering American Portland cement, *a* brand, *b* 1,362 bbls. at Gallipolis, O., *c* 1,560 bbls. at Maysville (price given per bbl. for cement delivered in bags), each bidder allows a rebate of 40 cts. per bbl. on sacks. Illinois Steel Co., Chicago, Ill., *a* Universal, *b* $1.95, *c* $2.03; Atlas Portland Cement Co., New York, N. Y., *a* Atlas, *b* and *c* $1.77; Alma Cement Co., Philadelphia, Pa., *a* Alma, *b* $1.72, *c* $1.85; Vulcanite Portland Cement Co., New York, N. Y., *a* Vulcanite, *b* and *c* $1.87; Virginia Portland Cement Co., New York, N. Y., *a* Old Dominion, *b* $1.82, *c* $1.74; The Miller Supply Co., Huntington, W. Va., *a* Lehigh, *b* and *c* $1.85; The Kelley Island Lime & Transport Co., Cleveland, O., *a* Lehigh, *b* and *c* $2; Alpha Portland Cement Co., Easton, Pa., *a* Alpha, *b* and *c* $1.80; Peninsular Portland Cement Co., Jackson, Mich., *a* Peninsular, *b* and *c* $1.87; Edison Portland Cement Co., Philadelphia, Pa., *a* Edison, *b* $1.65, *c* $1.75.

**Akron, O.*—John P. Jones is reported to have on June 27 secured the contract from the Co. Comrs. for constructing the Fox Lake ditch for $6,849.

Sandusky, O.—J. W. Miller, City Engr., writes in regard to harbor improvements for which the citizens recently voted to issue $125,000 bonds, that no definite plans have yet been made.

Portland, Ore.—Maj. W. C. Langfitt, Corps Engrs., U. S. A., writes that John Kiernan, of Portland, will probably secure the contract for mattress rock and pile work in connection with extension of jetty at mouth of Coquille River, Ore. (bids for which were opened June 22), for $48,648.

Panama.—All bids opened on June 15 by the Panama Canal Comn., at Washington, D. C., for excavation of and entrance to Inner Harbor, Canal Zone, Isthmus of Panama, are stated to have been rejected.

Bids will be received until July 31 by the Isthmian Canal Comn., Washington, D. C., for furnishing air compressors, pneumatic hammers, drills and boring machines, marine boilers, sheet iron, steel rivets, salinometers and salinometer pots, etc.

Pittsburg, Pa.—The Ohio & Pennsylvania Ship Canal Co. is reported organized with Jas. H. Cassidy, Pres., and Chas. F. Lang, Secy.-Treas., and preliminary work is stated to be in progress for the construction of a canal between Pittsburg and Ashtabula, connecting the great lakes with the Mississippi by way of Lake Erie and Ohio River. The project will involve an expenditure of about $25,000,000. Geo. M. Lehman, Pittsburg, Pa., is Ch. Engr.

The lowest bid opened on June 28 for the improvement of Lawrenceville Park is stated to have been submitted by Thos. Sweeney & Co., 32d St. and P. R. R., for $16,212.

**Items marked thus give the names of parties awarded contracts.*

The Cross Town Tunnel Co. is reported to have petitioned for a charter to construct a tunnel from 10th St. Bridge to Boyd and Forbes Sts.; probable cost of work, $250,000. Incorporators: Jas. H. Milholland, Howard G. Evans and others.

Bids are wanted July 31 for building 8 steel lock gates in Ohio River, as advertised in The Engineering Record.

Philadelphia, Pa.—The only bid received and opened by the Bureau of Yards & Docks, Navy Dept., Washington, D. C., on July 1 for dredging at navy yard, League Island, Pa., about 110,000 cu. yd., was submitted by the American Dredging Co., 510 Merchant & Mariner Bldg., Philadelphia, Pa., at 18½ per cu. yd.

Charleston, S. C.—The bid of P. Sanford Ross, Inc., of Jersey City, N. J., has been recommended for acceptance for dredging canal across Berwicks Island, S. C. (bids opened June 26 by Capt. G. P. Howell, Corps Engrs., U. S. A.). His bid was 17 cts. per cu. yd. for 50,000 cu. yds. dredging in marsh land, and 20 cts. per cu. yd. for 33,611 cu. yds. dredging high land, and 17 cts. per cu. yd. for widening 9,777 cu. yds. marsh land and 20 cts. for the high land; cost of inspection $236; total, $17,970. The other bids received were: Simons-Mayrant Co., Charleston, S. C., $17,983, and Atlantic, Gulf & Pacific Co., New York, N. Y., $19,250.

**Galveston, Tex.*—The Bowers Southern Dredging Co., of Galveston, is stated to have secured the contract for the new dredge for Galveston harbor (bids opened May 13) for $102,500.

The following are reported to be the bids opened on June 28 for the continuance of jetty work at Galveston, Aransas Pass and at the mouth of Brazos River (bidders all of Galveston): Chas. Clarke & Co., for the work as a whole on the three projects, $427,390; for the work separately on each project, $443,890. J. M. O'Rourke & Co. bid only for the work as a whole, $450,760. Suderman & Dolson bid only on each project separately, with a total of $469,445. I. Heffron & Son bid only on the Brazos River work at $111,695.

Cape Charles, Va.—Bids will be received on Aug. 3 by Capt. E. E. Winslow, Corps. Engrs., U. S. A., Norfolk, for dredging harbor at Cape Charles, as advertised in The Engineering Record.

Seattle, Wash.—Max Umbrecht is reported to be preparing plans for a new dock to be constructed at Railroad Ave. and Virginia St. for H. S. Holden, of Syracuse, N. Y. The plans contemplate a structure 240x100 ft. to cost $20,000.

PROPOSALS OPEN

For Proposals see pages 56, 58, 60, 61, 63 AND 64.

WATER WORKS.

Bids Close.		See Eng. Record.
Jul. 11.	System, Tama, Ia.	Jun. 24
Jul. 11.	System, Slatington, Pa.	Jul. 1
Jul. 11.	Pumping engine, Clinton, Minn.	Jul. 8
Jul. 12.	Pipe and machy., Whittier, Cal.	Jul. 1
Jul. 12.	Mains, New York, N. Y.	Jul. 1
Jul. 15.	Tunnel, Peabody, Mass.	Jul. 8
Jul. 17.	Bishopville, S. C. Adv. June 3 to July 8.	Jun. 3
Jul. 17.	**Valves, pipe, etc., Panama** Adv. Jun. 17 to Jul. 1.	Jun. 17
Jul. 17.	Pipe, Peterboro, N. H. Adv. July 8.	Jul. 8
Jul. 18.	System, Wahpeton, N. D.	Jun. 17
Jul. 18.	Mains and reservoir, Havre, Mont. Adv. Jun. 24, Jul. 1.	Jun. 24
Jul. 18.	Hydrants, etc., Washington, D. C.	Jul. 1
Jul. 19.	Pumps and engines, Panama Adv. June 24 to July 8.	Jun. 24
Jul. 19.	Pumps, Brooklyn, N. Y.	Jul. 1
Jul. 19.	Reservoir, Rochester, N. Y. Adv. Jul. 8.	Jul. 8
Jul. 19.	Mains, New York, N. Y.	Jul. 8
Jul. 19.	Pipe, etc., Long Island City, N. Y.	Jul. 8
Jul. 20.	Ft. Pierre, S. D.	Jul. 1
Jul. 20.	Tunnel, Chicago, Ill.	Jul. 8
Jul. 25.	Pipe, Cleveland Hgts., O.	Jul. 1
Jul. 28.	Valves, Cincinnati, O.	Jul. 8
Jul. 29.	Pumps, Brooklyn, N. Y.	Jun. 24
Jul. —.	Water wks., Morehead City, N. C.	Jun. 17
Aug. 1.	Charleston, N. H.	Jul. 8
Aug. 1.	Laying pipe, etc., Cincinnati, O. Adv. Jul. 8.	Jul. 8
Aug. 7.	Pumping plant, Winnipeg, Man. Adv. Jul. 8.	Jul. 8
Aug. 8.	Water works, Columbia, S. C. Adv. July 1, 8.	Jul. 1
Aug. 17.	Irrigation, Yuma, Ariz. Adv. June 17 to July 8.	Jun. 17

SEWERAGE AND SEWAGE DISPOSAL.

Bids Close.		See Eng. Record.
July 11.	Franklin, Ind.	July 1
Jul. 11.	Altoona, Pa.	Jul. 8
Jul. 12.	Mamaroneck, N. Y.	Jun. 24
Jul. 12.	St. Bernard, O.	Jul. 1
Jul. 12.	Cincinnati, O.	Jul. 8
Jul. 12.	New York, N. Y.	Jul. 8
Jul. 13.	Cincinnati, O.	Jul. 8
Jul. 13.	Galveston, Tex.	Jul. 8
Jul. 13.	Bellaire, O.	Jul. 8
Jul. 13.	Toledo, O.	Jul. 8
Jul. 15.	Youngstown, O.	Jul. 8
Jul. 17.	Groton, S. D.	Jun. 24
Jul. 17.	Westfield, Mass. Adv. Jun. 24.	Jun. 24
Jul. 17.	New Britain, Conn. Adv. Jul. 8.	Jul. 8
Jul. 17.	Brainerd, Minn.	Jul. 8
Jul. 17.	Corinth, Miss. Adv. Jul. 8.	Jul. 8
Jul. 17.	West Lafayette, Ind.	Jul. 8
Jul. 18.	Wahpeton, N. D.	Jun. 17
Jul. 18.	Lebanon, O. Adv. Jul. 8.	Jul. 8
Jul. 19.	Brooklyn, N. Y.	Jul. 8
Jul. 19.	Beloit, Wis.	Jul. 8
Jul. 21.	Utica, N. Y. Adv. June 17 to July 8.	Jun. 17
Jul. 22.	Ogden, Utah	Jul. 1
Jul. 24.	Washington, D. C. Adv. Jul. 8.	Jul. 8
Jul. 25.	Laurens, S. C. Adv. July 1, 8.	Jul. 1
Jul. 25.	Tampa, Fla. Adv. Jul. 8.	Jul. 8
Aug. 1.	**Toronto, Ont.**	Jun. 17
Aug. 1.	Washington, D. C. Adv. Jul. 8.	Jul. 8
Aug. 1.	Charleston, N. H.	Jul. 8
Aug. 1.	Anaconda, Mont.	Jul. 8
Aug. 5.	Alliance, O.	Jun. 24

BRIDGES.

Bids Close.		See Eng. Record.
Jul. 11.	**Castlewood, S. D.**	Jun. 10
Jul. 11.	**Wabasha, Minn.**	Jun. 17
Jul. 11.	Trenton, N. J.	Jul. 8
Jul. 12.	Providence, R. I. Adv. July 1, 8.	Jul. 1
Jul. 14.	Cleveland, O.	Jul. 1
Jul. 14.	Owen Sound, Ont. Adv. June 24	Jun. 24
Jul. 15.	Menominee, Wis. Adv. Jul. 8.	Jul. 8
Jul. 15.	Fargo, N. D.	Jul. 8
Jul. 17.	Binghamton, N. Y.	Jul. 8
Jul. 17.	Fresno, Col.	Jul. 8
Jul. 18.	Anderson, Ind.	Jul. 1
Jul. 18.	Marietta, O.	Jul. 1
Jul. 19.	Superstructure, Hartford, Conn. Adv. Jul. 8.	Jul. 8
Jul. 19.	Substructure, Hartford, Conn. Adv. Jul. 8.	Jul. 8
Jul. 20.	Oglethorpe, Ga.	Jul. 8
Jul. 20.	Charleston, W. Va. Adv. July 8.	Jul. 8
Jul. 20.	Litchfield, Minn.	Jul. 8

PAVING AND ROADMAKING.

Bids Close.		See Eng. Record.
Jul. 11.	**Telford road, Mt. Holly, N. J.** Adv. June 17 to July 8.	Jun. 17
Jul. 11.	Ashland, O.	Jun. 24
Jul. 11.	Cleveland Heights, O.	Jun. 24
Jul. 11.	Peekskill, N. Y.	Jun. 24
Jul. 11.	Elkton, Md.	Jul. 1
Jul. 11.	Ashland, O. Adv. Jul. 8.	Jul. 8
Jul. 11.	Sioux City, Ia.	Jul. 8
Jul. 11.	Rock Island, Ill.	Jul. 8
Jul. 12.	Freehold, N. J.	Jun. 24
Jul. 12.	Providence, R. I.	Jul. 1
Jul. 12.	Cincinnati, O.	Jul. 8
Jul. 12.	New York, N. Y.	Jul. 8
Jul. 13.	Bellaire, O.	Jul. 8
Jul. 14.	Clarinda, Ia.	Jul. 1
Jul. 15.	Boston, Mass.	Jul. 1
Jul. 15.	Crownpoint, Ind.	Jul. 1
Jul. 15.	Youngstown, O.	Jul. 8
Jul. 15.	Seattle, Wash.	Jul. 8
Jul. 15.	Panama	Jul. 8
Jul. 15.	Wheeling, W. Va.	Jul. 8
Jul. 17.	St. Paul, Minn.	Jul. 1
Jul. 17.	Bridgeport, Conn. Adv. July 1, 8.	Jul. 1
Jul. 17.	Montgomery, Ala.	Jul. 8
Jul. 17.	Jersey City, N. J.	Jul. 8
Jul. 17.	Niles, O.	Jul. 8
Jul. 17.	Delaware, O.	Jul. 8
Jul. 17.	Mt. Vernon, Ind.	Jul. 8
Jul. 18.	East St. Louis, Ill.	Jul. 8
Jul. 18.	Oneonta, N. Y. Adv. Jul. 8.	Jul. 8
Jul. 18.	McKees Rocks, Pa.	Jul. 8
Jul. 18.	Watertown, Conn.	Jul. 8
Jul. 19.	Hartford, Conn. Adv. Jul. 8.	Jul. 8
Jul. 19.	Brooklyn, N. Y.	Jul. 8
Jul. 20.	Washington, D. C. Adv. June 24 to July 8.	Jun. 24
Jul. 20.	Port Clinton, O.	Jul. 8
Jul. 21.	Creston, Ia.	Jul. 8
Jul. 22.	Des Moines, Ia.	Jul. 8
Jul. 24.	Flemington, N. J. Adv. July 1, 8.	Jul. 1
Jul. 25.	Tampa, Fla.	Jul. 1
Jul. 25.	Wilmington, N. C.	Jul. 8
Jul. 25.	Tampa, Fla. Adv. Jul. 8.	Jul. 8
Jul. 26.	Cincinnati, O.	Jul. 8
Jul. 27.	Xenia, O. Adv. June 24 to July 8.	Jun. 24
Jul. 27.	Ft. De Soto, Fla.	Jul. 8
Jul. 27.	Rhinelander, Wis.	Jul. 1
Jul. 27.	Cincinnati, O.	Jul. 8
Jul. 29.	New Orleans, La.	Jul. 8
—	Osceola, Ia. Adv. Jun. 24, Jul. 1,	Jun. 24
Aug. 1.	Belvidere, Ill.	May 20
Aug. 5.	Panama	Jul. 8
Aug. 8.	Shreveport, La.	Jul. 1

POWER, GAS AND ELECTRICITY.

Bids Close.		See Eng. Record.
Jul. 11.	Lincoln, Neb. Adv. Jun. 17 to 24.	Jun. 17
Jul. 12.	Buffalo, N. Y.	Jul. 8
Jul. 14.	Hastings, N. Y.	Jul. 8
Jul. 14.	Wausau, Wis.	Jul. 8
Jul. 15.	Pensacola, Fla.	Jun. 17
Jul. 15.	**Kings Mountain, N. C.**	Jun. 17
Jul. 17.	Eureka, Col.	Jul. 8
Jul. 18.	Washington, D. C.	Jun. 24
Jul. 18.	Washington, D. C.	Jul. 1
Jul. 20.	Fayetteville, N. C.	Jul. 8
Jul. 21.	Kansas City, Mo.	Jul. 8
Jul. —.	Morehead City, N. C.	Jun. 17
Aug. 2.	Indianapolis, Ind.	Jul. 8
Aug. 15.	Campbellsville, Ky.	Jun. 24
Aug. 24.	Fort Wayne, Ind.	Jul. 8
Oct. 1.	Tacoma, Wash.	Jul. 8

BUILDINGS.

Bids Close.		See Eng. Record.
Jul. 11.	**Hospital, Goshen, Ind.**	Jun. 10
Jul. 11.	Plumb. in school, Lexington, Miss.	Jul. 1
Jul. 11.	School, Indianapolis, Ind.	Jul. 1
Jul. 11.	Htg. school, Ironton, O.	Jul. 1
Jul. 11.	School, Alice, Tex.	Jul. 1
Jul. 11.	**Pub. Bldg., Trenton, N. J.**	Jul. 8
Jul. 11.	Plumb Armory, Buffalo, N. Y.	Jul. 8
Jul. 11.	School, Pittsburg, Pa.	Jul. 8
Jul. 12.	**Htg. court house, Cambridge, Minn.,**	Jun. 10
Jul. 12.	**P. O. Bldg., Deadwood, S. D.** Adv. Jun. 17 to 24.	Jun. 17
Jul. 12.	Hospital, New York, N. Y.	Jun. 24
Jul. 12.	School, Fremont, O.	Jul. 1
Jul. 12.	School, Lafayette, Ind.	Jul. 8
Jul. 12.	Engine house, Bucyrus, O.	Jul. 1
Jul. 12.	School, Georgesville, O.	Jul. 1
Jul. 12.	Station, Allegheny, Pa.	Jul. 8
Jul. 13.	**Pub. Bldg. Albion, N. Y.** Adv. Jun. 24 to Jul. 8.	Jun. 24
Jul. 13.	Pub. Bldg., New York, N. Y.	Jul. 8
Jul. 14.	School, Holyoke, Mass.	Jul. 1
Jul. 14.	Pub. Bldg., Buffalo, N. Y.	Jul. 8
Jul. 14.	School, St. Croix Falls, Wis.	Jul. 8
Jul. 14.	School, Springfield, Mass.	Jul. 8
Jul. 15.	**Hotel, Little Rock, Ark.**	Jun. 17
Jul. 15.	Jail, Ladysmith, Wis.	Jun. 24
Jul. 15.	Plans for school, Fayetteville, Ark.	Jul. 1
Jul. 17.	Post bldg., Ft. Warren, Mass. Adv. June 24 to July 8.	Jun. 24
Jul. 17.	Plans for school, Fayette, Ark.	Jul. 1
Jul. 17.	Schools, Columbus, O.	Jul. 1
Jul. 17.	Plumb. in schools, Cleveland Hgts., O.	Jul. 1
Jul. 17.	School, Harshman, O.	Jul. 1
Jul. 17.	Schools, New York, N. Y.	Jul. 8
Jul. 17.	Engine house, Chicago, Ill.	Jul. 8
Jul. 17.	Armory, Guelph, Ont.	Jul. 8
Jul. 17.	Plmbg., etc., in hospital, New York, N. Y.	Jul. 8
Jul. 17.	Pub. Bldg., Baltimore, Md.	Jul. 8
Jul. 18.	Schools, Wahpeton, N. D.	Jun. 17
Jul. 18.	Schools, Youngstown, O.	Jul. 1
Jul. 19.	Schools, Lancaster, O.	Jul. 1
Jul. 20.	Custom House, San Francisco, Cal.	Jun. 3
Jul. 20.	Court house, Mangum, Okla. Ter.,	Jul. 1
Jul. 20.	Courthouse, Manhattan, Kan.	Jul. 1
Jul. 20.	School, Montpelier, O.	Jul. 8
Jul. 21.	School plans, Concord, N. H.	Jul. 8
Jul. 22.	**Hospital, New Orleans, La.**	Jun. 17
Jul. 24.	**P. O. Bldg., Fargo, N. D.**	Jun. 17
Jul. 24.	School, Morning Sun, Ia.	Jul. 1
Jul. 24.	Court House, Washburn, N. D.	Jul. 8
Jul. 24.	Post bldgs., Ft. Mackenzie, Wyo. Adv. Jul. 8.	Jul. 8
Jul 25.	P. O. Bldg., Muncie, Ind. Adv. June 24 to July 8.	Jun. 24
Jul. 26.	P. O. Bldg., Spartansburg, S. C. Adv. Jun 24, Jul 1.	Jun. 24
Jul. 27.	Schools, Ft. Totten, N. D.	Jul. 1
Jul. 27.	Htg., etc., Post Office, Kansas City, Mo.	Jul. 8
Jul. 29.	Barracks, etc., West Point, N. Y. Adv. July 1, 8.	Jul. 1
Jul. 29.	Library, Cleveland, O.	Jul. 8
Jul. 29.	Jail, Newport, Ark.	Jul. 8
Jul. 30.	Court House improv., Leesville, La. Adv. July 8.	May 13
Jul. 31.	Light house bldgs., Detroit, Mich. Adv. July 1, 8.	Jul. 1
Jul. 31.	Vent. and htg. schools, Cleveland, O.	Jul. 8
Aug. 1.	**Y. M. C. A. Bldg., Spokane, Wash.**	**Apr. 29**
Aug. 1.	Library, Louisville, Ky.	Jul. 1
Aug. 1.	School, Port Arthur, Tex.	Jul. 8
Aug. 1.	Light house bldgs., Mobile, Ala.	Jul. 8
Aug. 1.	School, Washington, D. C.	Jul. 8
Aug. 5.	Pub. bldg., Bremerton, Wash.	Jul. 1
Aug. 7.	P. O. Bldg., Adrian, Mich. Adv. July 1, 8.	Jul. 1
Aug. 9.	**Pub. bldgs., Chicago, Ill.**	Jun. 17
Aug. 9.	School library, Bloomington, Ind. Adv. Jul. 8.	Jul. 8
Aug. 14.	Court House, Cedartown, Ga.	Jul. 8
—	Schools, North Providence, R. I.	Jun. 17
—	School, Phoenix, Ariz.	Jun. 24
—	Remodeling Court House, Taylorville, Ky.	Jun. 24

MISCELLANEOUS.

Bids Close.		See Eng. Record.
Jul. 11.	Supplies, Washington, D. C.	Jul. 1
Jul. 12.	**Dredging, Portland, Me.** Adv. Jun. 17 to Jul. 8.	Jun. 17
Jul. 12.	**Dredging, etc., Jacksonville, Fla.** Adv. June 17 to July 8.	Jun. 17
Jul. 12.	Dredging, New Orleans, La.	Jul. 1
Jul. 12.	Sign posts, New York, N. Y.	Jul. 8
Jul. 12.	Pier, Buffalo, N. Y.	Jul. 8
Jul. 13.	Garbage disp., Philadelphia, Pa.	Jul. 8
Jul. 14.	**Dredging, Boston, Mass.**	Jun. 17
Jul. 14.	**Dredging, Mobile, Ala.** Adv. June 17 to July 8.	Jun. 17
Jul. 14.	Pier, New York, N. Y.	Jul. 8
Jul. 15.	**Storage plant, etc., Pensacola, Fla.**	Jun. 17
Jul. 17.	**Wire, etc., Memphis, Tenn.** Adv. Jun. 24 to Jul. 8.	Jun. 24
Jul. 17.	Dredging, Philadelphia, Pa. Adv. June 17 to July 8.	Jun. 17
Jul. 18.	Supplies, Washington, D. C.	Jun. 24
Jul. 18.	Supplies, Washington, D. C.	Jul. 1
Jul. 20.	Dredging, Honolulu, H. I. Adv. June 24 to July 8.	Jun. 24
Jul. 20.	**Rem. of wreck, Charleston, S. C.** Adv. June 24 to July 8.	Jun. 24
Jul. 20.	Dredging, Norfolk, Va. Adv. Jul. 1.	Jul. 1
Jul. 21.	Mchy. for lock, Pittsburg, Pa.	Jun. 24
Jul. 22.	Dredging, Boston, Mass.	Jul. 1
Jul. 24.	**Destructor, Panama** Adv. Jun. 24 to July 8.	Jun. 24
Jul. 24.	Canal work, Portland, Ore.	Jul. 1
Jul. 24.	El. Rys., Panama	Jul. 8
Jul. 25.	Dredging, Chicago, Ill. Adv. July 1, 8.	Jul. 1
Jul. 27.	Steel barges, Panama Adv. July 1, 8.	Jul. 1
Jul. 29.	Dredging, etc., Bremerton, Wash.	Jun. 24
Jul. 29.	Supplies, Panama	Jul. 1
Jul. 31.	R. R. work, Miami, Fla. Adv. Jun. 24 to July 8.	Jun. 24
Jul. 31.	Air compressors, etc., Panama Adv. July 1, 8.	Jul. 1
Jul. 31.	Cement, Glendive, Mont. Adv. July 1, 8.	Jul. 1
Jun. 31.	Lock gates, Pittsburg, Pa. Adv. Jul. 8.	Jul. 8
Jul. 31.	Supplies, Panama	Jul. 8
Aug. 1.	Supplies, Washington, D. C.	Jul. 8
Aug. 2.	Dredging, Savannah, Ga. Adv. Jul. 8.	Jul. 8
Aug. 3.	Dredging, Cape Charles, Va. Adv. Jul. 8.	Jul. 8
Aug. 9.	Dock, Chicago, Ill.	Jun. 17
Aug. 26.	Coal plant, Olongapo, P. I.	May 6
Sep. 1.	**Steel and iron, Sydney, N. S. Wales.** **Adv. Apr. 8, 22; May 6, 20; Jun. 3, 17. Jul. 1.**	Apr. 8
Nov. 1.	R. R. work, Manila, P. I.	Jun. 17
Apr. 2,	'06. Harbor Work, Valparaiso, Chili, Adv. Apr. 29 to July 8.	Apr. 29
—	Dam, etc., Charlestown, W. Va.	Jul. 1

**Items marked thus give the names of parties awarded contracts.*